

GUIDELINES ON QUALITY SYSTEMS FOR ROADS

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ABBREVIATIONS

IRC	INDIAN ROADS CONGRESS
QA	QUALITY ASSURANCE
ISO	INTERNATIONAL STANDARDS ORGANISATIONS
MOST	MINISTRY OF SURFACE TRANSPORT (now MINISTRY OF ROAD TRANSPORT AND HIGHWAYS)
QCE	QUALITY CONTROL ENGINEER
TP	THIRD PARTY
E	ENGINEER/OWNER
C	CONTRACTOR

SECTION 1

INTRODUCTION

1.1. Background

A good road network has an important bearing on the economic growth of a country. Huge length of roads falling in various categories, such as, National Highways, State Highways, Major District Roads, etc., exist in the country and road construction projects comprising original construction work as well as repairs are being taken up all over the country on these roads.

In the changing scenario of globalization and economic liberalization, a great deal of emphasis is already laid on development of infrastructure through construction of a dependable road network. Consequently, consistency in the quality of road and incorporation of quality as major attribute in the organization entrusted with the task of road construction have assumed paramount importance.

Quality of a product or service has many aspects and the fact that quality should conform to the customer's requirements has now become the focal point in managing quality in all organizations/projects. However, quality was often considered as conformance to specifications particularly in the road sector and was based on detection at the end of production stage, thus, ensuring conformance to specified requirements entirely through inspection and testing of the product at the end. This was the quality control phase through which the road construction industry has been travelling in the recent past.

If one looks around in the corporate sector, it is revealed that mere conformity to specifications is no longer considered as a measure of quality and the major corporate organizations have switched to a Quality Assurance (QA) phase. The QA stresses on planned and systematic working with a view to eliminate non-conformities. Statistical process control techniques are employed to assure that the product meets specified requirements, rather than achieving it through detection and rejection of defectives at the end of production. The concept of quality assurance has already been employed through development of manual and procedures in a few of the major bridge/road projects in the country. However, the concept needs to be universalized so as to incorporate assurance of quality in all the road works being carried out.

The road construction industry, now employs the quality control approach in its work and the procedures and testing methodologies are brought out under publication of IRC: SP: 11 (Hand Book of Quality Control for Roads and Runways). While addressing to its terms of references, the IRC-Project Preparation, Project Contract and Management Committee (H-8) under the Chairmanship of Shri P.D. Wani took up the task of bringing out a revised draft of the above document. A Sub-Committee was constituted for this purpose under the Chairmanship of Shri K.B. Rajoria, Engineer-in-Chief, Public Works Department, New Delhi. During

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the meeting of this Sub-Committee held at New Delhi on 18.10.97, all the members present, expressed the need to incorporate the principles of quality assurance in the road construction works and accordingly it was decided to bring out guidelines on preparation of quality assurance manual for roads and runways. Shri S.M. Nerkar was entrusted the task of revising the IRC: SP:11. In line with MOST Specifications for Road Works, Third Revision, and Shri J. Ganguli was assigned the task of drafting the "Guidelines for Quality Assurance in Roads".

In the meantime, the IRC brought out a document IRC: SP: 47-1998 "Guidelines on Quality Systems for Road Bridges (Plain, Reinforced, Prestressed and Composite Concrete)" for bridges. This document incorporates the elements of quality assurance in respect of bridge works. In the IRC H-8 Committee meeting held at New Delhi on 8.11.1998, it was decided to revise the IRC: SP: 11 and also bring out a separate document for Quality Assurance System for Roads; on the lines of the document for bridges. Accordingly, the bridge document was kept in view while drafting the document pertaining to highways and road works.

The document as prepared by Sub-group was discussed in Project Preparation, Project Contract and Management Committee (H-8) in the meetings held on 31.1.99 at Hyderabad and on 28.8.99 at Mumbai. The Committee (personnel given below) approved this document in its meeting held at Mumbai on 28.8.99.

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The Guidelines were approved by the Highways Specifications & Standards Committee in its meeting held at New Delhi on 21.12.1999. Later on, these Guidelines were approved by the Executive Committee during its meeting held at New Delhi on 2.5.2000 and by the Council during its 159th meeting held at Pune on 26.5.2000.

The document presented herein incorporates the elements of quality assurance in highway and road works and should serve as a useful guide to organizations entrusted with managing quality in such works. Needless to say the approach towards quality assurance is based on the ISO-9000 standards which are currently being employed universally as QA Standards in managing quality.

1.2. Need for 'Guidelines on Quality Systems'

In order to achieve the aim of building safe, serviceable, durable and economic highways/roads, the road structure should meet certain requirements. The characteristics that a structure should possess to fulfill these requirements have to be specified. The codes of practice and the contract documents strive to achieve this by way of defining design criteria, practical rules, technical specifications, testing and acceptance criteria and workmanship. All these strategies implicitly depend upon human skills for their successful and reliable application which, eventually, determines the quality of highways/roads. The basic desire to produce quality work is essential in the minds of all those connected with highways/road projects.

In order to achieve the required level of quality of the final product, as specified by engineering science, it is necessary to have a strategy for management of human skills by way of Quality System defining quality policy, quality assurance plan and quality audit. Apart from this, it is also necessary to explicitly define 'Quality' itself, which is expected to be achieved through the Quality System. These guidelines have, therefore, been evolved to facilitate preparation of appropriate Quality System for individual highway/road projects. Use and application of these guidelines will inculcate, in all those involved in highway/road building activity, an ability to provide the product or services expected of them consistently, thereby, assuring the users and instilling confidence in the users.

In drafting these guidelines, an attempt has been made to achieve compliance with international codes on Quality Systems, published by International Standards Organization. Compliance with the present guidelines will be a step towards obtaining ISO Quality Certification, enabling Indian designers and contractors to compete internationally.

1.3. Scope

These guidelines cover quality systems for activities of highway/road construction using asphaltic, concrete pavements. These include project preparation, design and drawing, construction and supervision, contract management, quality of materials and equipment used in construction, and workmanship. The guidelines also cover the organizational requirement for adoption of quality system by suppliers, purchasers, owners, approving authorities and consultants.

These guidelines will enable:

- (i) Compliance with codal requirements of quality control.
- (ii) Setting up of internal quality systems for each of the organizations dealing with various aspects of highway/road construction.
- (iii) Setting up of external quality systems by the suppliers, to ensure conformance to specified requirements :
 - (a) At final inspection or,
 - (b) During production and installation, or
 - (c) During several stages, such as, design/development, production, installation and maintenance.
- (iv) Setting up of long term policies and procedures for quality systems.

1.4. Presentation

These guidelines are presented in the following sections:

- (i) Section 1 : Introduction
- (ii) Section 2 : General Approach
- (iii) Section 3 : Requirements of Different Classes of Quality Assurance
- (iv) Section 4 : Typical Quality Assurance Plan for Construction and Design
- (v) Section 5 : Typical Proforma

At the end of the guidelines, definitions and terminology are given as an **Annexure**.

SECTION 2

GENERAL APPROACH

2.1. Concept

The term 'Quality' has been defined as the totality of features and characteristics of a product or services that bear on its ability to satisfy stated or implied needs. In the contractual environments, needs/requirements are specified, whereas, in other environments implied needs/requirements should be identified and defined. The code of practice endeavours to meet the requirements by a three pronged strategy. Firstly, it specifies the acceptable materials of construction outlining the various tests of acceptance; secondly, it defines various design criteria practical rules and sound engineering practices for guiding the designers in arriving at appropriate structural solutions; and thirdly, it deals with the workmanship and other aspects of construction which ensure that the design intents are realised in actual construction. The contract documents and technical specifications define the inter-relation of various parties to the contract as well as the requirements of quality. All these strategies implicitly depend upon human skill for their successful and reliable application.

The total system of policy, management responsibility, internal and external control, testing and quality control, acceptance criteria, corrective action, and documentation is covered in the quality system. It also encompasses the overall organization structure, responsibilities, procedures and processes for implementing quality management. The aspect of overall management functions that determines the quality policy and implements it by such means as quality planning, quality control and quality assurance within its quality system, is referred to as 'Quality Management'.

The terms used in the field of quality management have acquired specific meanings and applications, different from the generic definitions found in dictionaries. Internationally accepted definitions and terminology have been included in **Annexure**, which also gives corresponding usage in relation to highway/road projects. The 'purchaser' or 'customer' is the term used for those who place order for the 'product' or 'service' and the term 'supplier' for those who undertake to procure/produce/supply the same. The quality of the product (or service) is ensured and maintained by following a documented 'Quality Plan' which sets out specific quality practices, including 'Quality Control' which are operational techniques of controlling quality. 'Quality Assurance' (QA) includes all those planned actions necessary to provide adequate confidence that the product (or service) will meet the requirements, and is essentially a system of planning, organising and controlling human skills to assure quality. Quality Assurance Plan sets out planned actions required for quality assurance. The continuous monitoring and verification of the status of QA activity to ensure that it is being followed is called 'Quality Surveillance'. 'Quality Policy' is a formally-documented statement of management's intentions and directions as regards to quality. 'Quality Audit' is a managerial tool used for reviewing the whole or a part of the quality system by internal or external agencies not connected with operation of QA plan. 'Total Quality Management'

brings to these concepts a long term global management strategy to achieve and improve quality and calls for the participation of all members of the organization for the benefit of the organization itself, its members, its customers and society as a whole.

2.2. Principal Components of Quality System

Implementation of quality system involves the following principal components:

(i) Supplier's Quality Policy

Commitment of the management of supplier to achieve and sustain quality of the product or service to meet purchaser's stated or implied needs, whether contractually required or not.

(ii) Purchaser's Quality Policy

Commitment of the management of the purchaser to obtain quality product or service to meet his stated or implied needs. This includes quality plan of the purchaser to satisfy himself about the quality of end product.

(iii) Internal Quality Systems

Internal quality systems of all concerned organizations including quality plan, quality assurance, control of non-conforming products, quality audits and corrective actions.

(iv) Inspection and Audit

Inspection and audit of internal quality systems, mutually conducted quality control tests, or independently conducted testing by third party and certification, so as to give confidence to purchaser or his appointed agent, when required by contract.

2.3. Requirements of Quality System

The requirements of quality system as given below are aimed primarily at achieving owner's satisfaction by preventing non-conformity.

(i) Management Responsibility

The supplier's management shall be responsible for quality policy. This will include resource mobilisation, organization of personnel defining clearly the responsibility, authority and inter-relation for performance, management and verification functions, lines of reporting, control of non-conforming product and review and updating.



(II) Quality System

The supplier shall establish, document and maintain a quality system including quality plans, quality manual and procedures.

(iii) Contract Review

Supplier shall establish and maintain procedures for contract review to ascertain that the requirements are adequately specified and understood and differences are resolved and recorded. He shall also ensure that he has the capability to meet the contractual requirements.

(iv) Design Control

Supplier shall establish and maintain documented procedures to control and verify the design to ensure that specified requirements are met. These should cover the aspects of design input, design activity, design output, design review, design verification, design changes and design validation.

(v) Document and Data Control

The supplier shall establish and maintain documented procedures to control all documents and data, which relate to the requirements of these guidelines.

This control shall ensure that obsolete documents are promptly replaced. The changes/modifications to documents should be promptly informed to all concerned and documents re-issued incorporating changes.

(vi) Purchasing

The supplier shall establish and maintain documented procedures to ensure that purchased product conforms to specified requirements. Evaluation of sub-contractors, maintenance of purchasing data and verification of purchased product, constitute important components of this requirement.

(vii) Control of Customer Supplied Products

The supplier shall establish and maintain documented procedures for the control of verification, storage and maintenance of customer-supplied products, provided for incorporation into the supplies or for related activities.

Verification by the supplier does not absolve the customer of the responsibility to provide acceptable product.



(viii) **Product Identification and Traceability**

The supplier should maintain data and documentation, which allow product identification and traceability during all stages of production and delivery.

(ix) **Process Control**

The supplier shall identify and plan the production, installation and processes that directly affect the quality and shall ensure that these are carried out under controlled conditions.

Documented procedures defining manner of production, use of equipment, compliance with reference to Standards/Codes, monitoring, control and approval of processes and workmanship constitute important components of process control.

Special situations where the quality of results cannot be fully verified by subsequent inspection/ testing of the processes shall be carried out by qualified operators and/or shall require continuous monitoring and control of process parameters to ensure that the specified requirements are met.

(x) **Inspection and Testing**

The supplier shall establish and maintain documented procedures for inspection and testing of activities in order to verify that specified requirements for the products are met.

Incoming product should not be used by supplier, prior to inspection and testing. However, in exceptional situations where it is, thus, used, it shall be positively identified and recorded in order to permit recall and replacement in the event of non-conformance to specified requirements.

In-process inspection and testing shall be carried out as required by quality plan and/or documented procedure.

The final inspection and testing shall be carried out in accordance with quality plan and/or documented procedures to complete the evidence of conformance of the finished product to specified requirements.

No product shall be despatched until all the activities of the quality plan have been satisfactorily completed. Where product fail to pass any inspection and/or test, the procedures for control of non-conforming product shall apply. Records shall identify the inspection authority responsible for release of product.

(xi) **Control of Inspection, Measuring and Testing Equipment**

Documented procedures to control, calibrate and maintain inspection, measuring and testing equipment shall be established and maintained. The equipments should be kept in good operating condition, calibrated at the specified frequency and used as per instructions. All records about the equipment including its identification, calibration, malfunction, repair and certification should be maintained.

(xii) **Inspection and Test Status**

The inspection and test status of products shall be identified by suitable means, which indicate conformance or non-conformance of product with regard to inspection and tests performed. Records shall be maintained to identify inspection and test status.

(xiii) **Control of Non-Conforming Products**

The supplier shall establish and maintain procedures to ensure that non-conforming product is prevented from inadvertent use or installation.

Non-conforming product shall be reviewed in accordance with the documented procedures for:

- (a) Reworking to meet the specifications,
- (b) Accepted with or without repair with concession,
- (c) Re-graded for alternative use, or
- (d) Rejected/scrapped.

These activities and their results should be fully documented.

(xiv) **Corrective and Preventive Actions**

The supplier shall establish document and maintain procedures for taking corrective and preventive actions to eliminate the causes of actual or potential non-conformities and appropriate with the risks. This would include investigation of causes of non-conformities and recording of any changes to the documented procedures resulting from such actions.

(xv) **Handling, Storage, Packaging, Preservation and Delivery**

The supplier shall establish document and maintain procedures for handling, storage, packaging, preservation and delivery of product.

The supplier shall arrange for the protection of the quality of products after final inspection and test. Where contractually specified, this protection shall be extended to include delivery to destination:

(xvi) **Control of Quality Records**

The supplier shall establish and maintain documented procedures for identification, collection, indexing, access, filing, storage, maintenance and disposition of quality records. Quality records shall be maintained to demonstrate conformance to the required quality and the effective operation of the quality system. Pertinent sub-contractor's quality records shall be an element of these data.

Retention times of quality records shall be established and recorded. Where agreed contractually, quality records shall be made available for evaluation by the purchaser or his representative for an agreed period.

(xvii) **Internal Quality Audits**

The supplier shall establish and maintain documented procedures for planning and implementing internal quality audits to verify whether quality activities comply with planned arrangements and to determine the effectiveness of the quality system.

Internal audits shall be scheduled on basis of the status and importance of the activity to be audited.

The management personnel responsible for the area shall take timely corrective action on the deficiencies found by the audit.

(xviii) **Training**

The supplier shall establish and maintain procedures for identifying the training needs and provide for the training of all personnel performing activities affecting quality. Personnel performing specific assigned tasks shall be qualified on the basis of appropriate education, training, and/or experience as required. Appropriate records of training shall be maintained.

(xix) **Servicing**

Where servicing is specified in the contract, the supplier shall establish and maintain procedures for performing, verifying and reporting that servicing meets the specified requirements.

(xx) **Statistical Techniques**

Where appropriate, the supplier shall establish procedures for identifying need for statistical techniques required for controlling and verifying process capability and product characteristics.

(xxi) Safety

The supplier shall establish and operate safety systems covering all activities on a highway/road project. Regular safety audits shall be done to activities on the basis of status and importance. The management personnel responsible for this aspect of contract management shall take timely corrective action on deficiencies, if found.

2.4. Quality Assurance and Quality Assurance Manual

Quality Assurance (QA) is defined as all the planned and systematic activities implemented within the Quality System and demonstrated as needed, to provide adequate confidence that an entity will fulfill the requirements. A Quality Assurance Manual (QAM) provides a base document outlining policy, procedures, responsibilities, compliance, acceptance criteria and documentation. It should be prepared and accepted by all parties concerned before start of project.

It should generally cover the following:

- (a) Identification of all parties involved in QA and their inter-relationship.
- (b) Internal QA system of each party.
- (c) Levels of cross-checking/verification in case of multiple verifications/controls, including systems of inspection and audit, wherever applicable.
- (d) Organization of personnel, responsibilities and lines of reporting for QA purposes.
- (e) Criteria for acceptance/rejection, including identification of proper authorities for such decisions.
- (f) Inspection at the end of defect liability period.
- (g) Items to be covered in maintenance manual.
- (h) All formats for documentation.

Though, several parties may be involved in enforcing quality assurance for any particular item of work or a product, the ultimate responsibility of compliance with QAM and of achieving required quality generally rests with one party. When process and/or product control is carried out by the supplier/producer or his agent, it is termed as internal control or 'one level' control. For important items of work, independent parallel checks/supervision are carried out by one or more agencies, either on full scale or on sample basis. This is normally carried out as external control or second level control. In some cases, third level of control may also be required, such as, that by a regulatory body or by insurance agency. These levels of control parties, their functions and inter-relation between them should be clearly defined in the Quality Assurance Manual. The Manual also should identify the responsible parties, their functions and inter-relation between them.

2.5. Classes of Quality Assurance for Roads

Depending upon the levels of checking/cross-checking and controls, required to provide adequate confidence, four classes of quality assurance are mentioned below :

Classes of quality assurance	Class Nomenclature
(1) Nominal QA	Q - 1
(2) Normal QA	Q - 2
(3) High QA	Q - 3
(4) Extra High QA	Q - 4

There will be four classes of QA for Highway/Road construction.

2.6. Guidelines for Selection of QA Class for Highway/Road Projects

Prior to 'Project Preparation' stage, one of the four classes of QA should be chosen for the project. This classification should be reviewed depending on site specific problems and types of solutions being evolved. At this stage the final selection of the overall QA class of the project should be made. Simultaneously, decision regarding upgradation of class for some of the activities, if found necessary, should be made as explained in Section 3.2 of this document.

The following guidelines are given for selection of appropriate QA class for Highways/Roads. The word roads include Village Roads, Other District Roads and Major District Roads and Highways include State, National Highways and Expressways.

For roads described above, the owners must prescribe encourage implementation of an appropriate QA as per the guidelines given below:

Selection of a QA class (out of Q-1, Q-2, Q-3 and Q-4 class) for a particular situation will have to be made diligently taking into account the speciality of the situation, e.g., A road normally coming under Q-1 or Q-2 class if located close to coast, high altitude, high rainfall, needs to be classified under Q-3 class.

An appropriate QA class needs to be selected right from the investigation stage and further for preparation of project, execution of project, etc.

Large projects of upgradation of State Highways to National Highways will have to appropriately classified in Q-3 or Q-4 class depending upon the provisions for upgradation.

Quality Assurance requirements for these four QA classes are given in Table No.3.1. Various activities, like, project preparation, design and drawings, contractual aspects, etc. for these four QA classes may be

performed either by the In-house staff or by external agency depending upon the Importance and the QA class of the project, e.g., data collection for the project preparation for Q-1 class can be done by In-house staff. Whereas, data collection for Q-3 class will have to be done through specialised agencies and cross-checking may be through in-house agency. Such important differentiation of the inputs in case of these four QA classes for different activities are enumerated in the Table 3.1.

- (1) Q-1 class QA is recommended for Village Roads
- (2) Q-2 class QA is recommended for the following:
 - (a) Other District Roads
 - (b) Major District Roads
- (3) Q-3 class QA is recommended for the following:
 - (a) State, National Highways
 - (b) Coastal Roads.
 - (c) Roads in high altitude. (Decide quality classification based on IRC:SP:20 -Appendix-B)
 - (d) Roads in high rainfall areas average over 2000 mm
- (4) Q-4 class QA is recommended for the following:
 - (a) Motorways/Expressways
 - (b) Roads in Tunnels/Urban Underpasses
 - (c) Roads built over high water table areas (Subgrade within a range of 1500 mm from capillary fringe defined in IRC:34-1970)
 - (d) Roads built over reclaimed land
 - (e) Elevated highways in urban areas not covered under IRC:SP:47-1998

2.7. Quality Assurance Manual for Highways/Roads

2.7.1. The owner, consultant, approving authority, main contractor, material suppliers, specialist/ nominated sub-contractors, manufacturers of materials being incorporated in permanent works are the parties involved in the overall QA system for road construction.

Typical organisational structure for various parties involved in design and construction (owners, consultants, contractors) are given in Figs. 2.1, 2.2 & 2.3.

2.7.2. Various activities on a road project can be classified under three groups.

- (1) Design
- (2) Construction
- (3) Manufacturing

2.7.2.1. In design activity, purchaser is the authority who places the order for design and/or project preparation. It may be either the owner of the road as in the case of preparation of detailed design, or the contractor, as in the case of design and construct contracts. Supplier is the consultant who undertakes to prepare the design. The design, drawings and tender documents are the end products. The QA manual should cover those requirements of quality system, which concern services or expertise.

2.7.2.2. In construction activity, purchaser is the authority who places order for the construction of road. Supplier is the contractor who constructs the road. In this case, the end product is the road.

2.7.2.3. Manufacturing activities fall under the following two categories.

The first category consists of factory manufactured item for general use, like, aggregates, cement, bitumen/bitumen products, reinforcement, etc. Quality assurance for manufacture of these items need not be covered under the Quality Assurance Manual for Roads.

However, the requirements of quality system pertaining to the specifications of quality, testing and acceptance procedure, procurement, storage, traceability and such other relevant items, which are to be carried out by owner/designer/contractor, should be covered therein.

The second category of manufactured items cover chain link fencing, road markers, lane dividers, lighting masts, energy absorbing terminals, road signs, etc. manufactured by specialist suppliers and are purchased for use as finished products by the contractor. The quality assurance manual should cover the quality assurance of such items.

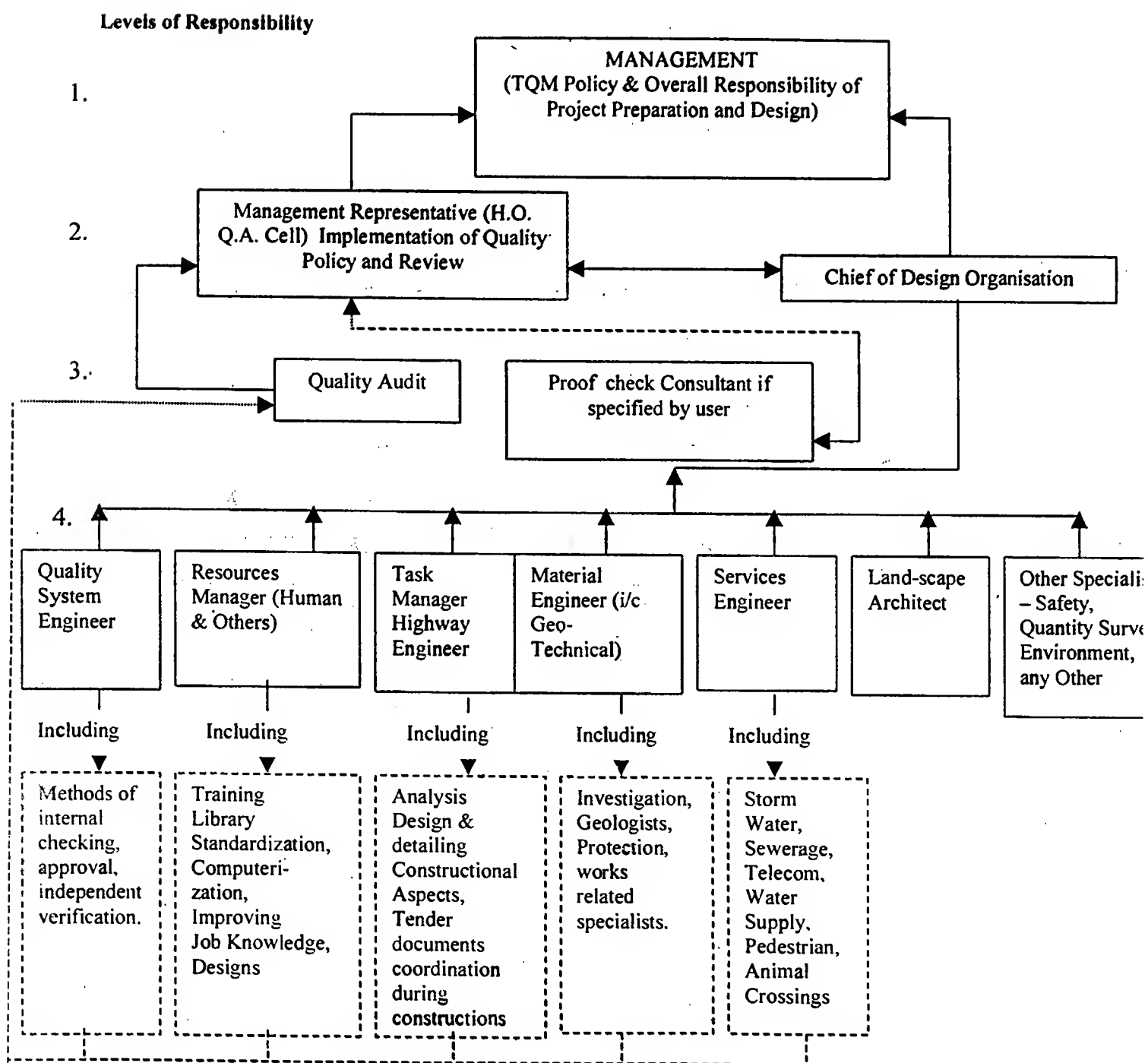
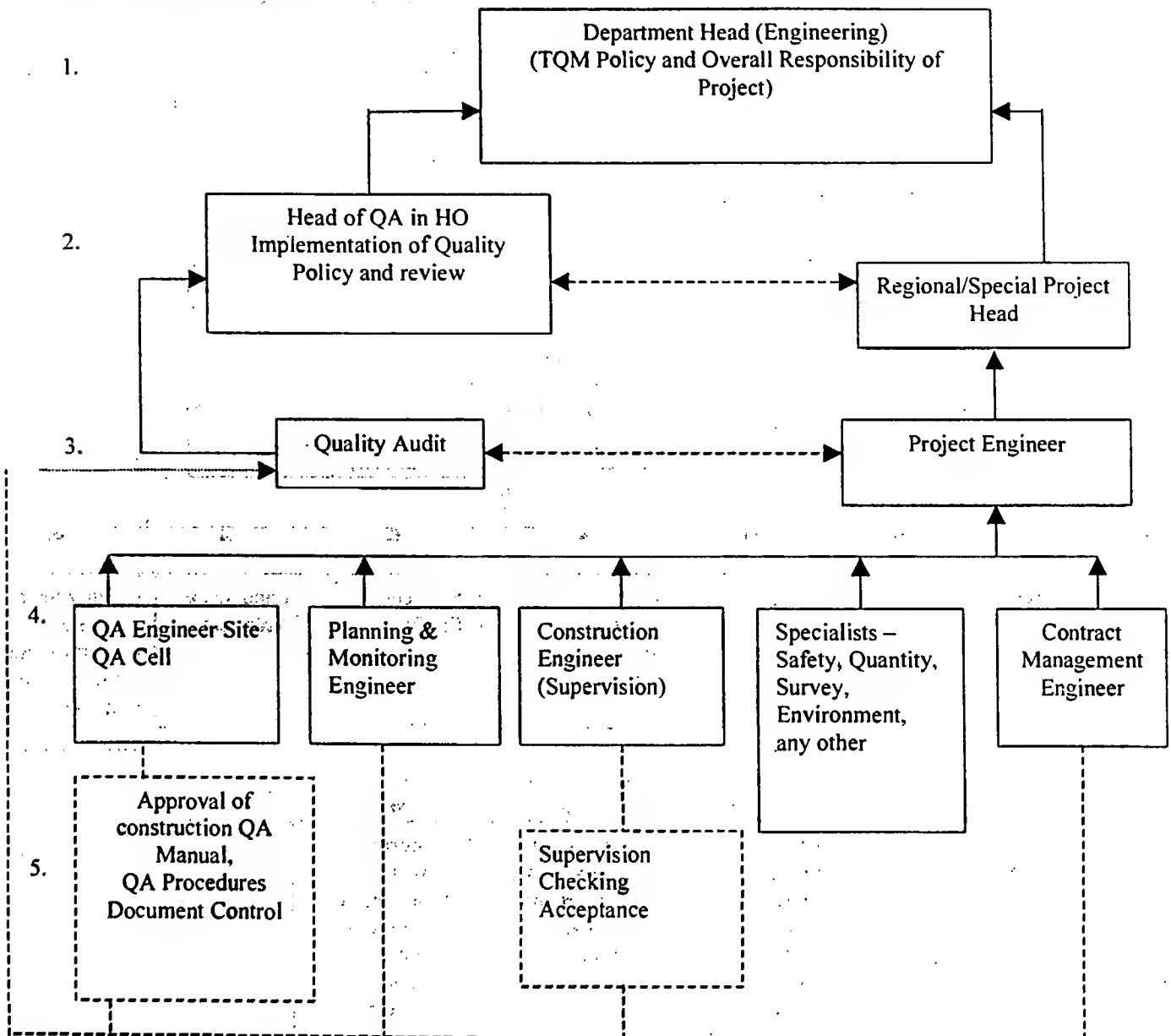
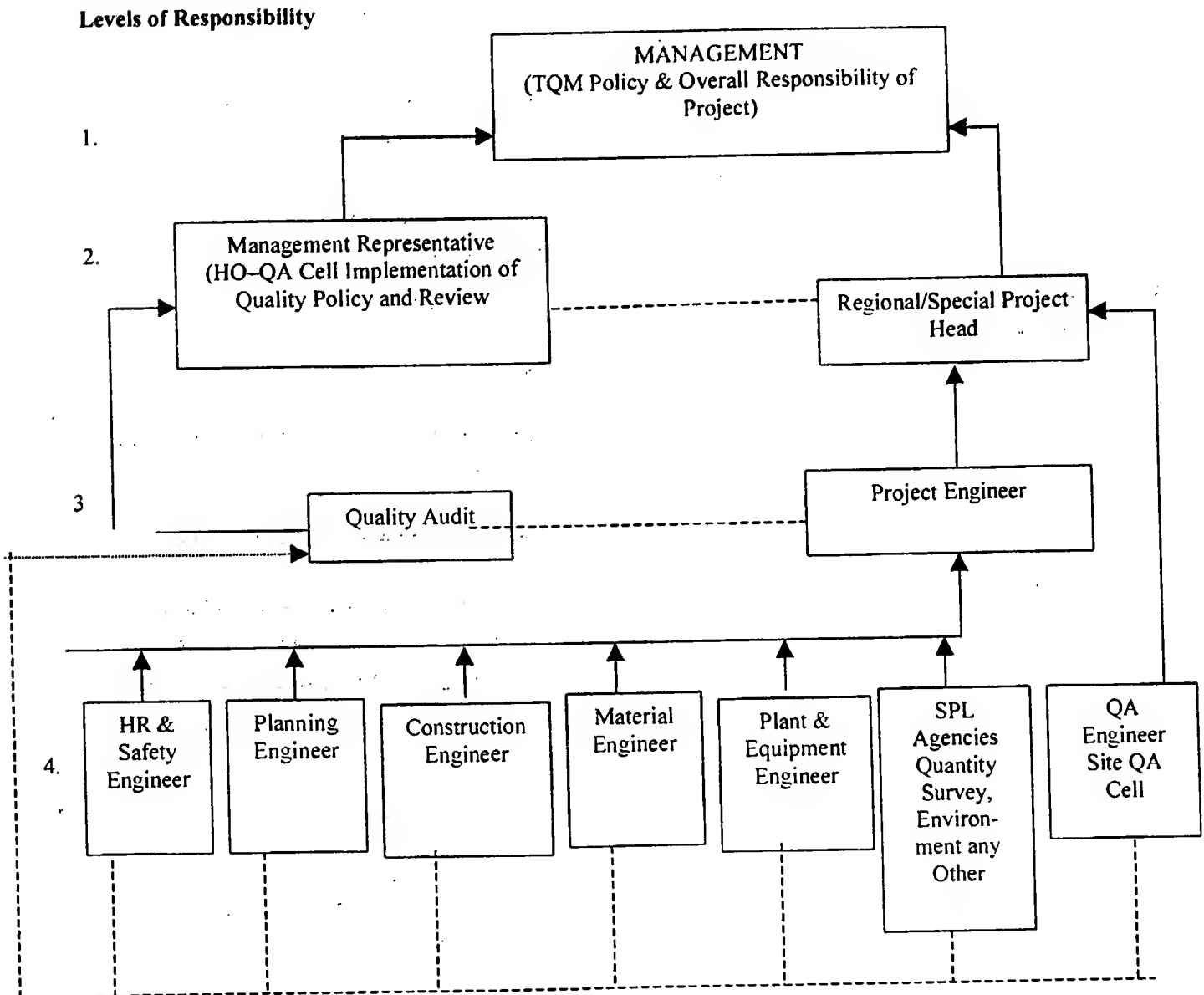
Fig. 2.1. ORGANISATIONAL STRUCTURE FOR OWNER

Fig. 2.2. QA ORGANIZATION FOR CONSTRUCTION (OWNER/CONSULTANT)**Levels of Responsibility****Note:**

- (1) The organigram indicates levels of responsibility of four rows. The lines of reporting for execution of work and responsibility for quality are shown by full lines and arrowheads. The working level interactions are indicated by dotted lines. The decisions concerning relative priorities and differences between equal levels are to be taken at higher level of responsibility.
- (2) For Q-2, Q-3, Q-4 QA Classes responsibility shown in each box need separate group of personnel with group need.
- (3) The organigram is basic. Amend suitably depending on QA class required.
- (4) QA Engineer at Level 4 also report to Regional/Special Project head

Fig. 2.3. QA ORGANIZATION FOR CONSTRUCTION (CONTRACTORS)

**Notes:**

- (1) The organigram indicates levels of responsibility in four rows. The lines of reporting for execution of work and responsibility for quality are shown by full lines and arrowheads. Working level interactions are indicated by dotted lines. The decisions concerning relative priorities, and about differences between equal levels are to be taken at higher level of responsibility.
- (2) For Q-3 & Q-4 QA Classes, the responsibilities shown in each box need separate group of personnel with group head.
- (3) The organigram is basic, can be altered to suit specific requirements.

2.7.2.4. Main aspects of activities which affect the quality of a road are highlighted below.

ACTIVITY	MAIN ASPECTS AFFECTING QUALITY
A. Project preparation (Data collection, selection of suitable options, project document)	<ul style="list-style-type: none"> i) Adequacy and accuracy of data, and surveys (including material survey); reliability of data source; and documentation. ii) Solutions based on codes and practices, taking into account for relevant local and past experience and documentation. iii) Documentation of all alternatives considered. iv) Review before finalization.
B. Design and drawings	<ul style="list-style-type: none"> i) Detailed Design Basis Report ii) Detailed designs, documentation and cross checking iii) Review for constructability and availability of intended construction expertise. iv) Internal review before finalisation or proof checking. v) Drawings to indicate availability of approved borrow area, quarries, potable water sources and place for disposal of unfit materials. The design assumption on usage of the above to be clear, but not to be made mandatory. vi) Provision of facilities for carrying out inspection, maintenance and repair/strengthening.
C. Preparation of Contract Documents	<ul style="list-style-type: none"> i) Standardised general conditions of contract including enforceable defect liability clauses, procedures for decision making, in-built mechanism for settlement of disputes, appropriate financial conditions and reasonable payment schedules. ii) Standardised detailed technical specifications. iii) Stipulation of the type and capacity of essential equipment to be used.

- iv) Provision and availability of required facilities at site.
 - v) Stipulations with regard to project organisation of contractor as well as the project management organisation of the owner.
 - vi) Stipulation for preparation of QA manual.
 - vii) Stipulations for submission of completion report with all supporting documents and 'as - built' drawings.
- D. Organization and Management of Suppliers/Contractors
- i) Management's Quality Policy
 - ii) Qualified and experienced technical work force and deployment of trained supervisors/workmen in adequate strength.
 - iii) Preparation of Quality Assurance Manual including provision for quality audit.
 - iv) Mobilisation of adequate resources including suitable plant and equipment.
 - v) Continuous planning, review and corrective action
 - vi) Adequate financial input including cash-flow and fund management.
 - vii) Prequalification of sub-contractors/suppliers.
- E. Material Procurement
- i) Material specifications including stipulation of Q.C. tests and acceptance/rejection criteria.
 - ii) Quality assurance plan defining documentation with special stress on traceability.
- F. Production of items and sub-items of construction (like, concrete, asphalt, emulsion, etc.)
- i) Adequate stipulation regarding workmanship.
 - ii) Drawings and other documents giving design intent.
 - iii) Ensuring adequate supervision and quality assurance.
 - iv) Inspection and quality surveillance.

- G. Management and Organization of Owners/Consultant
- v) Deployment of proper and adequate plant and equipment.
 - vi) Relevant items covered in (D) & (E) above.
 - i) Management's Quality Policy
 - ii) Project specific Q.A. plan
 - iii) Project organization including deployment of competent personnel.
 - iv) Ensuring adequate supervision and quality surveillance.
 - v) Provision for quality audit.

SECTION 3



IRC:SP:57-2000

QUALITY ASSURANCE REQUIREMENTS OF DIFFERENT CLASSES OF QUALITY

3.1. General

This section contains detailed guidelines indicating requirements of different classes of quality for road projects. The selection of a class for projects is discussed in Section 2. The requirements of quality control and level (degree) of control are given in Table 3.1 under six sub-heads, as follows:

- (1) Project Preparation
- (2) Design and Drawings
- (3) Contractual Aspects
- (4) Construction Organizations
- (5) Materials
- (6) Workmanship

Aspects of projects preparation as well as designs and drawings have been covered briefly, and are indicative of the general approach. However, the aspects of construction affecting quality are covered in greater detail.

3.2. Project-Specific QA Plan

The contents of the table provide broad check-list of various activities for a typical road project. List A as indicated is not to be considered complete. It may be modified to suit any specific project requirement/specification. Based on this table and QA class chosen in accordance with Section 2 a detailed 'project-specific' quality assurance plan shall be prepared. All relevant factors must be considered in detail before finally choosing the overall quality assurance class for a particular project or even for particular activities within the project itself, taking into account the consistency of the QA requirements for all critical components of the road. Such QA plan is normally prepared by the owner or by construction agency and when prepared by the latter, it is scrutinized and approved by the Owner or the Consultants to the project. The QA plan shall be documented in the form of QA Manual. The QA plan/manual so prepared should form part of the contract agreement.

A typical QA plan for construction activities is illustrated in Section 4.

3.3. Implementation

Implementation of quality assurance plan may be carried out by the following methods:

- (1) Internal control by the construction agency.
- (2) External control either by the owners or by the third party inspection agency.

The choice of agency for enforcement of quality assurance plan should preferably be spelt out in the tender documents.

TABLE 3.1. QUALITY ASSURANCE REQUIREMENTS *

Sl. No.	Item	Nominal QA Q-1	Normal QA Q-2	High QA Q-3	Extra High QA Q-4
1. PROJECT PREPARATION					
1.1.	Adequacy and reliability of data	Data collection from primary local sources through in house staff	Data collection from primary local sources. Either in-house or other agencies	Data collection through specialised agencies; cross checking through in-house agencies	As in Q-3 but with specialised agencies using sophisticated methods
		Verification and certification at local level within the organization	Verification and certification by senior level or central level within the organization	Verification and certification by external agency	Verification and certification by external agency
1.2.	QA Systems and documentation	Project prepared and approved following QA systems and in-house verification	As in Q-1, but independent checking and review through a separate in-house unit	As in Q-2 but independent checking through an external agency	QA systems and documentation prepared and checked by external independent agency

❖ *Note:* - The Quality Assurance requirements listed are minimum for general situation. The user has to modify to suit his/her contract specification.

Sl. No.	Item	Nominal QA Q-1	Normal QA Q-2	High QA Q-3	Extra High QA Q-4
1.3.	Topographical Survey	Mapping, longitudinal alignment, level monuments by in-house staff Random check by in-house staff not connected with the project	Same as Q-1, but 100 per cent checking by in-house staff not connected with the project	Mapping and drawing preparation by specialised agency. 100 per cent check by third party like Consultants	Same as Q-3
	Survey equipment	Manual equipments, like, 20 second theodolites dumpy levels, plain table or as suitable. Duly calibrated	More accurate equipments, like, 1 second theodolite, auto levels, etc. suitably calibrated	Electronic distance measuring equipments, auto levels, etc. suitably calibrated. Use of computer aided drafting recommended	Same as Q-3. For large projects aerial surveys may be considered. Use of computer aided drafting recommended

Sl. No.	Item	Nominal QA Q-1	Normal QA Q-2	High QA Q-3	Extra High QA Q-4
2. DESIGN AND DRAWINGS					
2.1.	Organization	Owners in-house and verification by owner through a separate in-house department having established QA procedures	Same as Q-1 but independent checking through in-house or external agency	External organization with approved QA systems for checking and review	External organization but checking and review by proof check agency who are independent
2.2.	(a) Drawings (Longitudinal Profiles, cross-sections)	Can be based on typical design with amendments to cover variation	Can be based on typical design but checked by external agency. To suit actual conditions	Project specific drawings made at pre-execution stage by external agency	Same as Q-3.
	(b) Cross drainage and other services	Can be based on typical design with amendments to cover variation	Can be based on typical design but internally checked by external agency to suit actual conditions	Project specific drawings made at pre-execution stage by external agency	Same as Q-3
	(c) Road furniture	Can be based on typical design with notes to cover variation	Can be based on typical design, but checked by in-house or external agency to suit actual conditions	Project specific drawings made pre-execution stage by external agency	Same as Q-3

Sl. No.	Item	Nominal QA Q-1	Normal QA Q-2	High QA Q-3	Extra High QA Q-4
3.	CONTRACTUAL ASPECTS (CONTRACT DOCUMENT)				
3.1.	a) Pre-qualification (Main Contractor)	From approved list of contractors	Same as Q-2	Preferable to prequalify contractors on basis of PQ applications	Pre-qualifications essential
	b) Suppliers/Sub-contractors	Approval during progress of work by appropriate authority	Same as Q-1	Pre-qualification prior to engaging the sub-contractor	Same as Q-3
	c) Nominated sub-contractor/agency	Ordinarily not required	Same as Q-1	Where required, to be specified in tender	Same as Q-3
3.2.	a) Specification and contract documents	Following standard general items of work and specifications	Same as Q-1 if special specifications are required for any item of work refer Q-3	Complete contract documents with full specifications including all relevant codes should be available at site. Specifications for non-standard items to be detailed, finalised and approved at appropriate level of responsibility	Same as Q-3
	b) Prebid meeting	Not required	Not required	Preferable	Essential

Sl. No.	Item	Nominal QA Q-1	Normal QA Q-2	High QA Q-3	Extra High QA Q-4
4. CONSTRUCTION ORGANIZATIONS					
4.1.	Organization of contractor	Contractors execution staff responsible for supervision and surveillance of quality	As in Q-1 but with additional surveillance by client	As in Q-2 with third level surveillance by independent agency	As in Q-3
4.2.	Organization of owner/project management consultant	In-house quality surveillance team	In-house quality surveillance team backed by consultant's team	Independent quality assurance team, additional to Q-1	As in Q-3
4.3.	Organization for planning of construction activities	Planning by contractor and approved by owner	<p>Planning by contractor and approved by project management consultant.</p> <p>Execution of work after intimation to owners representative</p> <p>Use of bar charts for monitoring</p>	<p>Construction activities planned in details, including material sourcing, sequencing work, resource planning method of quality control</p> <p>Use of networks review at regular intervals and resource levelling</p>	<p>As in Q-3 with involvement of specialists for planning of innovative work</p> <p>As in Q-3 but with monitoring by owner</p>

Sl. No.	Item	Nominal QA Q-1	Normal QA Q-2	High QA Q-3	Extra High QA Q-4
4.4.	Supervision	Full time supervision for all construction activities by owner	Full time supervision for all construction Periodic visits by designer/ owner	As in Q-2 with additional full time supervision by independent agency, where required	As in Q-3 with additional specialist supervision for innovative aspects
4.5	Quality surveillance	Quality surveillance by contractors engineers and owners representatives	Quality surveillance by contractors independent team in addition to consultant	As in Q-2 but with random audit by special agencies	As in Q-3

Sl. No.	Item	Nominal QA Q-1	Normal QA Q-2	High QA Q-3	Extra High QA Q-4
5. MATERIALS					
5.1.	General a) Materials from natural sources	Purchases from large and established traders Source mutually agreed to between contractor and client and documented May rely on local past experience	Purchased from large and established suppliers/traders independent testing and acceptance by contractors/ owners QA and documented Testing and acceptance at start of project and at frequent intervals as per specifications	As in Q-2 and/or with own source of supply Independent testing and acceptance by contractors/ owners QA and documented Testing and acceptance at start of project and at specified intervals	Third level testing and acceptance by an approved laboratory Same as Q-3

Sl. No.	Item	Nominal QA Q-1	Normal QA Q-2	High QA Q-3	Extra High QA Q-4
	b) Factory manufactured items including cement, steel, bitumen	Manufacturers test certificate accepted with same tests by an independent agency prior to incorporation in permanent works ISO-9000 certification for manufactured items not essential	Same as Q-1 Same as Q-1	Manufactures tests sample checks for initial acceptance only Regular testing at specified frequencies during construction based on mutually agreed QA procedures ISO-9000 Certification preferable. Manufacturer with ISO certification may be given preference	Same as Q-3 Same as Q-3 but with an independent agency for third level check Same as Q-3
	c) Records for all materials	Record purchase dates and retain manufactures test certificate	As in Q-1	As in Q-2, Also record location of use, issue date	AS in Q-3
	d) Testing facilities	Testing from nearby established test houses	Physical testing facilities at site. Special tests to be done at independent labs	Same as Q-2 Audit on the site laboratory by independent agency	Same as Q-3

Sl. No.	Item	Nominal QA Q-1	Normal QA Q-2	High QA Q-3	Extra High QA Q-4
5.2.	a) Coarse aggregates - Grading	At the beginning for mix design and every change of source. Conduct routine tests as per specifications	At the beginning for mix design and every change of source/stock. Conduct routine tests	Sampling and testing daily at production facility. Conduct routine tests as per specifications	Same as Q-3
	- Other physical tests (crushing value, abrasion, flakiness index, stripping moisture, etc.	For selection of source, if in doubt, conduct periodic tests as per test and inspection plan.	For selection of source, if in doubt, conduct periodic tests as per test and inspection plan.	At the beginning for mix design, and every change of source/codal stipulations	Same as Q-3
	- Deleterious contents	For selection of source if in doubt, conduct periodic tests as per specifications	Same as Q-1	Mandatory for selection of source and whenever there is change in source of supply/as per codal stipulations	Same as Q-3

Sl. No.	Item	Nominal QA Q-1	Normal QA Q-2	High QA Q-3	Extra High QA Q-4
	Aggregate reactivity	Not applicable	Not applicable	Mandatory for selection of source and whenever there is change in source of supply	Same as Q-3
	b) Fine aggregate (Sand/ crusher run)	At the time of mix design, for every stack, change of source	At the time of mix design, for every stack, change of source	At the time mix design, stack change and at increased frequency at site laboratory as per specifications	Same as Q-3
	c) Borrow Materials				
	1) Grading	At the time of selection and every change of borrow	Same as Q-1	Every 3000 Cum. of borrow operation-2 tests.	Same as Q-3
	2) Physical tests	At the time of selection and every change of borrow	Same as Q-1	Every 3000 Cum. of borrow operation-2 tests	Same as Q-3
	3) Deleterious materials	At time of selection	At the time of selection	At time of selection and once weekly	Same as Q-3

Sl. No.	Item	Nominal QA Q-1	Normal QA Q-2	High QA Q-3	Extra High QA Q-4
5.3.	Water Suitability	At beginning	At beginning	At beginning and at increased frequencies in site lab after every monsoon	Same as Q-3
	Chemical analysis	Carried out if in doubt	Carried out if in doubt	Mandatory at beginning and at start of working season	Same as Q-3
5.4.	Cement—Normal physical and Chemical tests	Manufacturers tests acceptable. Test in case of non-availability of certificates	As in Q-1	Additional to manufacturers tests sample and test random deliveries	As in Q-3 sample and test each delivery
	Form of purchase, storage, transportation and use within acceptable time limit	Trade purchases, storage in dry and covered places, covered transportation use of factory filled machine stitched bag	As in Q-1	Directly from factory to site godown or silos. Transportation supervised and documented. Encourage bulk cement containers	As in Q-3

Sl. No.	Item	Nominal QA Q-1	Normal QA Q-2	High QA Q-3	Extra High QA Q-4
5.5.	Admixtures				
	a) Approval	Approval after trials under supervision	Approval after trials by contractor, independent trial by PMC/owner	<ul style="list-style-type: none"> - Independently carried out acceptance testing after field trials for each sources. - Retrials with change in source of cement, routine checking by testing for every batch of admixture. Manufacturers data/certificate acceptable as basis of comparison for production lot.	-As in Q-3 with additional independent tests. 1) Chloride contents. 2) Spectroscopic signature of accepted product as basis of comparison for production trials.
	b) Dosage dispensing and production controls at site	Manual dispensing under supervision. Monitoring of workability required	Automatic dispensing required - Specific gravity checks to be frequent - Continuous workability monitoring required	Same as Q-2	Same as Q-2
			- Visual inspection of concrete after striking forms for local defects (delayed setting)		

Sl. No.	Item	Nominal QA Q-1	Normal QA Q-2	High QA Q-3	Extra High QA Q-4
	c) Training of site staff by manufacturer	Demonstration on usage required	Training of site staff in use as well as quality control, plus periodic visits by manufacturers experts	Same as Q-2	As in Q-2. But visits by experts at close frequency
5.6.	Reinforcing steel Normal physical tests.	Accept manufacturers tests certificates. If not available test independently	Once at the beginning and for every change in source in addition to manufacturers test certificates	As in Q-2 and for each consignment	As in Q-3 but further supplemented by random QA checking
	Chemical composition	Accept manufactures test certificates. If not available test independently	Same as Q-1 if in doubt test independently	Once at beginning and if in doubt for every source change	Same as Q-3
	Welding	Not ordinarily permissible at site. However, permissible subject to employing a qualified welder	Same as Q-1	Welding to be done only by qualified and tested welders. -Electrodes to be specified- Random testing of joints for strength	As in Q-3, but welders to be periodically tested and also welding to be examined by experts after destructive tests

Sl. No.	Item	Nominal QA Q-1	Normal QA Q-2	High QA Q-3	Extra High QA Q-4
5.7.	Bitumen & Bitumen Products, Road Markings, Signs, Furniture				
	Normal physical tests	Accept manufacturers test certificate. If not available test independently	Test in the beginning and for every change in source additional to manufacturers tests	Test every consignment prior to receipt at site	Test every consignment prior to receipt in addition to tests at source
	Chemical tests	Accept manufacturers test certificate. If not available test independently	Test in the beginning and for every change in source additional to manufacturers tests	Same as Q-2	Same as Q-2 with additional tests at source by independent QA department
5.8.	Road marking paints				
	Normal Physical tests	Accept manufacturers test certificates if not available test independently	Same as Q-2	Same as Q-2 additionally test random batches	Same as Q-3 test random batches independently
5.9.	Road signs	Accept manufacturers test certificates	Same as Q-1	Same as Q-2 additional witness test at manufactures works	Accept manufacturers QA Audit systems regularly
5.10.	Road furniture	Accept manufactures tests and certificates	Same as Q-1	Accept manufacturers QA systems and audit regularly	Same as Q-3 but audit by independent agency



Sl. No.	Item	Nominal QA Q-1	Normal QA Q-2	High QA Q-3	Extra High QA Q-4
6.	WORKMANSHIP				
6.1	General controls direct and indirect a) Working and supervision	Skilled and semi-skilled workers Periodic supervision from owner or his agent	Same as Q-1 Same as Q-1	Skilled workers having special training to be insisted Full time supervision from contractor and owner	Same as Q-3 As in Q-3 with occasional expert supervision
			Periodic check by designer	As in Q-2 with predetermined frequency	As in Q-3
				Documentation of inspection and certification of compliance by designers representative	As in Q-3
	b) Use of mock-ups	Not ordinarily required	Not ordinarily required	Required for certain elements of works which should be specified in tender documents to be carried out in presence of designer, QA team of owner To Simulate actual site conditions. No work on site to be permitted prior to demonstrative mock-up	As in Q-3



Sl. No.	Item	Nominal QA Q-1	Normal QA Q-2	High QA Q-3	Extra High QA Q-4
6.2.	Mix designs subbase, base and pavement courses	Mix design performed at beginning of work or for new source of materials with subsequent QC as per code and by experienced supervisors	As in Q-1	As in Q-1 with minimum of two levels of controls	As in Q-3.
6.3.	Fabrication and fixing of reinforcement	Site bending by skilled workers with regular checking by supervisors.	Same as Q-1	Same as Q-1	As in Q-1
			Bar schedules are made and checked before use	Same as Q-2	Schedule made by design office and issued for use
			Placement of reinforcement checked independently before covering up	As in Q-2 but checked by QA team	As in Q-3
6.4. Form Work					
	a) Materials	Any suitable material conforming to codes and capable of giving desired finish	Same as Q-1	System form work	System form work
	b) Design checks	Spot checks	Spot checks	Design checked approved independently	Same as Q-3
	c) Tolerances, geometry tightness	Frequent checks by carpenters. Random checks by supervisor	Frequent checks by carpenters and supervisors	Checks for all members by supervisory staff	Same as Q-3

Sl. No.	Item	Nominal QA Q-1	Normal QA Q-2	High QA Q-3	Extra High QA Q-4
6.5. Earth Works					
	a) Tests for density	As per MOST	As per MOST	As per MOST specifications, each compacted layer	Same as Q-3
	b) Geometry check	Final layer	Final layer	All layers	Same as Q-3
	c) Equipment	Static rollers required	Vibratory rollers preferred	Vibratory rollers mandatory	Vibratory rollers mandatory
6.6. Granular Sub-Bases					
	a) Material	-	Premix preferred	Premixed to suitable grading as per Mix Design required	Same as Q-3
	b) Laboratory tests	-	Random sampling and testing	Each layer to be sampled from location and tested all as per MOST	Same as Q-3
	c) Geometry checks	-	Top layer	All layers	As per Q-3
6.7. Granular Bases/Binder Coarse Bases					
	Materials				
	a. Aggregate	Hand broken acceptable	Crushed preferred	Crushed and screamed mandatory	Same as Q-3
	b. Binder quality	Accept manufacture TC, conduct routine tests	Same as Q-1	Qualify source – test every consignment at arrival	Quality source: Test every consignment, employ third party if required
	Workmanship				

Sl. No.	Item	Nominal QA Q-1	Normal QA Q-2	High QA Q-3	Extra High QA Q-4
	a) Paving	Manual procedure acceptable	Mechanical paver preferred	Sensor paver mandatory	Same as Q-3
	b) Compaction	Static equipment acceptable	Vibratory equipment preferred	Vibratory equipment mandatory	Same as Q-3
	c) Geometry checks	Top layer	All layers	All layers	All layers
6.8. Wearing Coarse—Asphalt/Concrete					
	a) Material/Aggregates	Hand broken aggregate acceptable	Crushed aggregate preferred	Crushed/Screened aggregates mandatory	Same as Q-3
	b) Mixing	Site mixing acceptable	Plant mixing preferred	Plant mixing mandatory	Same as Q-3
	c) Paving	Manual acceptable	Paver preferred	Paver mandatory	Paver mandatory
	d) Compaction	Static equipment acceptable	Vibratory equipment preferred	Vibratory equipment mandatory	Same as Q-3
	e) Geometry checks	Top layer	Top layer	All layers	All layers using sophisticated equipment

SECTION 4

TYPICAL QUALITY ASSURANCE PLAN FOR DESIGN AND CONSTRUCTION

4.1. Introduction

Quality planning to assure quality of product has been adopted over the last few decades for special and complex projects. However, in case of highway engineering and construction, efforts in this regard are visible only in the recent years. As a result of continuing efforts, it has become possible to evolve appropriate methods and level of documentation for Quality Assurance plan for highway projects.

Surveillance of project implementation, if well organized into a quality assurance plan, contributes towards quality. For this, step by step procedures which would help in achieving consistent and comprehensive methods of checking and approval of works at every stage, need to be established and documented. These procedures should be reviewed periodically, amended, as found necessary, and revised documents prepared.

All parties involved in the QA plan should have their internal QA systems clearly defined in form of a specific Quality Assurance Manual (QAM) for the respective purposes, such as, QAM for manufactured products (by the manufacturers or suppliers). It is also necessary for owner/purchaser to have his own internal QA plan. QAM for highway project as a whole integrating all these plans shall be prepared/or approved by the owner and/or approving authority, if any. Each vendor (i.e., supplier, designer, contractor, manufacturer) will thus, have his own internal QA procedures which are required to be agreed upon, in advance, with the purchaser of the respective activity. As highway building in India is mostly undertaken by Govt. agencies, it is necessary that the contractor/designer obtains concurrence of their QAM from the concerned Government Department ('Department'). The Guidelines provided in Sections 2 and 3 should be used by the respective parties in evolving of the operational QAM to be agreed between the contractor and the Department for adoption at site.

Quality assurance plan for a road construction project, documented in quality assurance manual, would essentially comprise the following aspects:

- Organisation
- Control of data and documentation, both product (roads) related documents and quality related records together with control documents.

- Q.A. procedure for setting out of works and temporary works.
- Methodology of working.
- Control of materials.
- Traceability and product identification (if required by clients).
- Calibration.
- Control of workmanship aspects.
- Protection during construction stage.
- Non-conforming products.
- Quality audit.

4.2. Organisation

In most of the cases, the management of the constructor shall be responsible for jointly reviewing the requirements of the project with the owner and structuring the appropriate organisation for the same. This project specific organisation is headed by Project Engineer. The duties among the staff below him could be generally on the following functional lines:

(a) Planning Engineer

Covering all aspects of work planning, resource requirements of both materials and labour, progress review and internal interface activities.

(b) Materials Engineer

In-charge of material management including procurement and quality control aspects, viz., inspection, field sampling and testing.

(c) Construction Engineer (No. as per requirement)

In-charge of various construction activities and responsible for following approved working methods, drawings and specifications.

(d) Plant, Equipment and Instrumentation Engineer

In-charge of deployment, operation, maintenance of various mechanical and electrical plant and equipment as well as instrumentation needed at site for construction.

(e) **Service Engineer**

In-charge of laying/relocation of buried services along/crossing the alignment.

(f) **Landscape Architect**

Will be generally involved at design stage and partly during construction stages.

(g) **Safety Engineer**

Responsible for preparation and implementation of safety systems within the construction site in addition to ensuring safety of Public/Traffic using part of the roadway under construction.

(h) **Survey Engineer**

Responsible for all topographic, land surveys and setting out of works as per drawings.

(i) **Quality Assurance Engineer**

Responsible for all aspects of preparation, review, acceptance of quality plan and operation of the same at site. He is also in-charge of quality related records and documents.

(j) **Quality Audit**

Independent team reporting to management.

The duties of assisting engineers and supervisory staff at various levels should be clearly specified as are relevant to the quality assurance systems, depending on the specific project requirements and size. The number of staff doing various functions listed above can be increased/decreased.

(Note: The organizational designation of persons performing above tasks will depend upon the constructors' organizations)

4.3. Control of Data and Documentation

4.3.1. Road related documents

Drawings, specifications, work instructions and other road related documents shall be maintained as described below to ensure that only the latest approved documents are used for the construction of each part of the work, which covers both the temporary and the permanent works:

(c) **Test Results**

This set of proformae is meant for recording the results of day-to-day tests carried out in accordance with the requirements or specifications. The proformae are usually maintained in two forms; one is loose leaf system for recording the various observations during each test and second is for recording the summary of test results in a register form to facilitate later analysis.

(d) **Daily Diary of Work and Quantity Records**

Elaborate registers are required to be maintained at site to record the day-to-day operations, activities and events taking place at the site of work, such as, equipment deployed, manpower deployed, activities carried out, different types of materials consumed, detailed observations of the activities at site (foundation strata, tilts, shifts, etc.), visits by senior level engineers and follow-up of their instructions. These records will enable preparation of the completion report as well as investigating any unusual observations, which come to notice afterwards.

(e) **Non-conforming Products**

Detailed statements have to be prepared describing the procedures to be followed as soon as any result not conforming to the requirements (or unusually better results) is obtained. Such statements deal with the (i) procedures to be adopted for rectification of the particular component where such result have been noticed, (ii) the long term corrective action, and (iii) immediate preventive actions in other similarly affected activities till the long term corrective actions are implemented.

(f) **Quality Audit**

A separate set of proformae with detailed instructions are laid down for facilitating the audit of the quality assurance by an independent unit at periodical intervals.

4.4. **QA Procedure for Setting out Works and Temporary Works**

A professional qualified surveyor is to be appointed to take responsibility of survey control and setting out both the temporary as well as the permanent works and establishing and maintenance of control stations, following approved work methods. Proper quality records shall be maintained. Under this item, the various elements to be covered should include:

- Survey control stations
- Setting out points

- Schedule of stations and points
- Control and checking of stations
- Approval of stations and setting out

Temporary works

Construction of temporary works shall be the responsibility and liability of the contractor. The work shall be done with the approval of the 'Engineer'

The design of the temporary works should also be got approved by the contractor from the 'Engineer'. Temporary works are generally as under:

- (a) Centering and formwork
- (b) Temporary structures built to enable/house operating plant/machinery
- (c) Detours of temporary nature for traffic
- (d) Services detour

The procedure for maintaining records of temporary works shall include:

- Design, drawings, method statement, etc.
- Checking and approval of proposal of temporary works
- Erection procedures
- Checking and approval of erection
- Certification by competent authority
- Monitoring during loading and use
- Dismantling temporary works

The above items should be checked by the appropriate authorities from the 'Engineer'.

4.5. Methodology of Working

Method statements for the execution of the permanent work as per the drawings/specifications shall be submitted by the Contractor to the 'Department' for approval. The procedure for this shall generally include:

- Submission of method statements to 'Engineer'
- Checking of the proposal
- Trials of method, if required any assessment of trials

- Sample of the permanent works and its assessment
- Execution of permanent work, and
- On-going review of the method

4.6. Control of Materials

The main aspects for materials to be covered in the QA Plan are as under:

- Testing of materials for source approval
- Inspection and certification of materials on receipt
- Testing of materials going into construction
- Test records
- Assessment and analysis
- Test frequencies and calibration schedule
- Storage and issue of materials
- Inventory

4.7. Control of Workmanship Aspects

To achieve the desired workmanship at various stages of work, it is necessary to carry out inspection in a regular and systematic manner.

The constructor shall devise an appropriate system for such inspections and get it approved from the 'Engineer'. Following points should be considered for inspection of various components/operations

- Method statements including tolerances
- Request forms for inspection
- Inspection proformae
- Authority levels for inspection
- Inspection procedures (preliminary, periodic and on completion checks)
- Check lists to systematise the inspections
- Record inspection

The above points should be considered for the various activities involved in construction, such as, grading, compaction, paving, etc.

4.8. Protection during Construction Stage

In order to produce a quality end product, it is necessary to lay down procedures for preventing any damage or deterioration of the various materials brought to site as well as the works partially completed or fully completed till the completion of the entire job.

These procedures will have to be laid down in respect of the following:

- (a) Storage of materials, like, cement, rebars, aggregates, bitumen, emulsions, inflammable solvents, etc.
- (b) Protection of the partially completed components of the road, both from the point of view of structural stability (including the hydraulic factors) and from the adverse effects of the environment.
- (c) Prevention of accidents to the structure as well as all personnel working on the project due to incomplete work or works in progress.

If any deterioration is noticed inspite of protective measures, the same is to be rectified before taking up subsequent operations.

4.9. Non-Conforming Products

For quality assurance of the finished work, it is necessary for the materials and workmanship to fully comply with the work requirement. Non-conforming work has to be dealt with as per procedures for dealing with non-conformities as per Proforma F1.

Special situations, however, arise, such as, strength of concrete, where non-conformance may only be known after sometime, e.g., after 28 days. Therefore, separate detailed procedures should be laid out for dealing with such non-conforming concretes (Refer Proforma E-1 for further guidance).

4.10. Quality Audit

The Quality Assurance Manager of constructor and 'Department' shall objectively evaluate the extent of compliance with the quality systems and their effectiveness. The audit shall include the process and product quality audit as well as the assessment of adequacy of systems as laid out in QA Manual.

The audit programme shall assign qualified personnel to perform such audits and define the procedures and frequency of audits, the method of reporting the findings and recommendations and the means for corrective actions and their re-audit.



4.11. Design Aspects

It is assumed in the earlier sub-section that the design is not the contractor's responsibility and is separately finalised by the Department. However, where the contractor is also to supply the design, the QAM should include the agreed procedures for the items listed below to achieve QA in design:

(a) **Organisation and Functional Responsibilities (Including Personnel Qualifications)**

Responsibilities for ensuring quality by persons in-charge of design and assuring that the stipulated quality indeed has been achieved (assurance function of QA team) need to be clearly defined.

(b) **Design Basis Report for Development of Design**

This includes:

- **Requirements of project/client**
 - Preliminary drawings and data: source, responsibilities of supply and methods of verification
 - Design approach, applicable codes, special design specifications
 - Methods of analysis, calculation, checking and internal approvals
 - Contents of design reports (detailed calculations)
 - Final drawings
 - Checking and approval by external approving authority, if any

(c) **Preparation and approval of design**

This includes:

- QA on software (prior testing and verification)
- Design preparation
- Design verification (independent review, alternative analysis and qualification testing)
- Interface control (internal and external)
- Control of manufacturers/vendors design
- Approval to design, distribution of design documents and document control
- Design change requests
- Checking and approval by external approving authority, if any

(d) **Audit and corrective actions**

(e) **Design documentation and records**

4.12. Proformae of Quality Records

As mentioned earlier, exhaustive and detailed proformae will have to be evolved and prescribed for the above purpose for each of the major highway to suit its special requirements, which form a part of the Quality Assurance Manual for the project. However, certain typical proformae which have been adopted on some of the work sites in India, are attached for each of the category to give an idea of the structure of these forms. These are not complete in themselves and they need to be modified, augmented or supplemented according to the needs of a particular work.



SECTION 5

TYPICAL PROFORMAE

Note:

Typical Proformae which have been adopted on some of the work sites in India are attached to give an idea of the format of these Proformae. These are indicative and may be modified, augmented or supplemented according to the needs of a particular work. The proformae are divided into categories:

Category A:	Planning Proformae
Category B:	Inspection Proformae
Category C:	Calibration Proformae
Category D:	Surveillance Proformae
Category E:	Proformae for Registers and Records
Category F:	Proformae for Procedural Guidelines of QA System.

QUALITY PLAN FOR COARSE AND FINE AGGREGATE

Sr. No.	Description Tests/Items	Acceptance Standard	Performance Standard	Performing Agency	Quality Assurance Agency	Frequency of Performance	Frequency of Assurance	Frequency of Audit
1	Prequalification of source	IS 383	IS 2386 and Project Specification	QA/E	QA/E/TP	Before call of tenders and award of work	Submission in the form of report	1
1A	Confirmation of sources	IS 383	IS 2386 and Project Specification	E/C	QA/E/TP	Immediately after award of work and before commencement of concreting	Submission in the form of report	1
2	Procurement	Project Specification	Project Specification	C	QA/E/TP	As per requirement	Well in advance of requirement	1
3	Storage	Project Specification	Project Specification	C	QA/E/TP	Immediately after receipt	As required	1
4	Sampling	Project Specification/IS 383	Project Specification/IS 383	E	QA/E/TP	As per IS 383	As per IS 383	1
5	Test :							
5A	Petrographic Analysis	IS 383/2386 ASTM 295	IS 383 ASTM 295	Authorised TP	QA/E/TP	New source or change in quality	New source or change in quality	1

Contd...

Category A: Planning Proforma A-1

Sr. No.	Description Tests/items	Acceptance Standard	Performance Standard	Performing Agency	Quality Assurance Agency	Frequency of Performance	Frequency of Assurance	Frequency of Audit
5B	Alkali reactivity	IS 383 IS SP 23	IS 2386	Authorised TP	QA/E/TP	New source or change in quality	New source or change in quality	1
5C	Chloride & Sulphate	IS 383 IS SP 23	IS 2386 ASTM D 1411	Authorised TP	QA/E/TP	New source or change in quality	New source or change in quality	1
5D	Deleterious Material	Project Specification/ IS 2386	Project Specification/ IS 2386	E/C	QA/E/TP	One sample per week	One sample* per week	1
5E	Crushing value	Project Specification/ IS 2386	Project Specification/ IS 2386	E/C	QA/E/TP	New source / As per requirement	New source / As per requirement	1
5F	Abrasion (optional)	Project Specification/ IS 2386	Project Specification/ IS 2386	E/C	QA/E/TP	New source / As per requirement	New source / As per requirement	1
5G	Impact value	Project Specification/ IS 2386	Project Specification/ IS 2386	E/C	QA/E/TP	New source / As per requirement	New source / As per requirement	1
5H	Soundness	Project Specification/ IS 2386	Project Specification/ IS 2386	E/C	QA/E/TP	New source / As per requirement	New source / As per requirement	1

Contd...

Category A: Planning Proforma A-1

Sr. No.	Description Tests/Items	Acceptance Standard	Performance Standard	Performing Agency	Quality Assurance Agency	Frequency of Performance	Frequency of Assurance	Frequency of Audit
5I	Size and Gradation	Project Specification	IS 2386	E/C	QA/E/TP	Daily	Daily	1
5J	Flakiness/Elongation	Project Specification	IS 2386	E/C	QA/E/TP	One sample * per week	One sample per week	1
5K	Coating and stripping of bitumen aggregate mixtures	AASHTO- T182		TP	QA/E/TP	One sample * per week	One sample per week	1
5Li	Sp. Gravity and Absorption (Normal Agg.)	Project Specification	IS 2386	E/C	QA/E/TP	One sample * per week	New source	1
5Lii	Sp. Gravity and Absorption (Heavy ore)	Project Specification	IS 2386	E/C	QA/E/TP	One sample * per week	New source	1
5M	Density/Moisture content	Project Specification	IS 2386	E/C	QA/E/TP	Daily	Daily	1

* E: ENGINEER/OWNER C: CONTRACTOR TP: THIRD PARTY QA: QA UNIT

Record :

Record shall be maintained by QA, who will verify, compile and analyse the data.

* One sample per week or as per MOST whichever is minimum.

Prepared by
(for QA Team)

Approved by :
(For Engineer)

Signed

Date

Signed

Date

Category A: Planning Proforma A-2

QUALITY PLAN FOR BITUMEN

Sr. No.	Description Tests/Items	Acceptance Standard	Performance Standard	Performing Agency	Quality Assurance Agency	Frequency of Performance	Frequency of Assurance	Frequency of Audit
1	Prequalification of source	Project Specification IS-73	Project Specification IS-73	E/C	QA/E/TP	New Source	New Source	1
2	Procurement	Project Specification IS-73	Project Specification IS-73	Agency Responsible for procurement	QA/E/TP	Well in advance	Well in advance	1
3	Storage	Project Specification	Project Specification	C	QA/E/TP	After receipt at Site	Once in month	1
4	Sampling	Project Specification	Project Specification	E/C or Jointly	QA/E/TP	Each fresh lot	Once in week	1
5	Test : Physical	Project Specification IS-73	Project Specification IS-73	E/C	QA/E/TP	Each lot	Once in week	1
	Chemical	Project Specification IS-73	Project Specification IS-73	E/C	QA/E/TP	As per requirement	As per requirement	1
6	Records	Project Specification	Project Specification	E/C	QA/E/TP	Daily	Once in month	1

QA: QA UNIT

TP: THIRD PARTY

C: CONTRACTOR

E: ENGINEER/OWNER

Approved by :
(For Engineer)

Signed Date

Date

Signed

Prepared by
(for QA Team)

QUALITY PLAN FOR MIXING WATER/ICE (CRUSHED)

Sr. No.	Description Tests/items	Acceptance Standard	Performance Standard	Performing Agency	Quality Assurance Agency	Frequency of Performance	Frequency of Assurance	Frequency of Audit
1	Prequalification	Project Specification/ IS 456 IS SP - 23	Project Specification	E	QA/E/TP	New source	New source	1
2	Confirmatory Tests	Project Specification/ IS 456 IS SP - 23	Project Specification	E/C	QA/E/TP	Before start of project work	As per requirement	1
3	Sampling	Project Specification	IS 456 Specification	E/C	QA/E/TP	New source thrice in a year (change of season)	Thrice in a year (change of season)	1
4	Physical and Chemical Tests	Project Specification	IS 456/ IS (Chemical Analysis)	E/C	QA/E/TP	New source thrice in a year	Thrice in a year	1
5	Storage	Project Specification	Project Specification	E/C	QA/E/TP	Daily	Once in a month	1
6	Cleaning of Storage Tank	Project Specification	Project Specification	E/C	QA/E/TP	Once in a month	Once in a month	1
7	Adequacy of Storage Tank	Project Specification	Project Specification	E/C	QA/E/TP	Before commencement of work	Once in a month	1

Record : Record shall be maintained by QA, who will verify, compile and analyse the data.

Signed

Date

Prepared by

(for QA Team)

Signed

Date

Approved by :

(For Engineer)

Category A: Planning Proforma A-4

QUALITY PLAN FOR CONCRETE ADMIXTURE

Sr. No.	Description Tests/items	Acceptance Standard	Performance Standard	Performing Agency	Quality Assurance Agency	Frequency of Performance	Frequency of Assurance	Frequency of Audit
1	Prequalification and recommendation	IS 9103/ ASTM C494	IS 9103/ ASTM C494	Agency responsible for procurement	QA/E/TP	Minimum 6 months before commencement of work	Before start of work and when source is changed	1
2	Procurement	Project Specification	Project Specification	-do-	QA/E/TP	Before start of concreting	Well in advance	1
3	Storage	-do-	Manufacturer/ Project Specification	E/C	QA/E/TP	After receipt at site	Once in a month	1
4	Sampling	Project Specification/ IS 9103	Project Specification/ IS 9103	E/C or Jointly	QA/E/TP	On arrival of fresh stock/ Minimum once in 3 months	New stock or once in 3 months	1
5	Tests							
5.1	Chemical Analysis	IS SP-23 IS 9103	IS 9103	E	QA/E/TP	As per requirement minimum once in a year	As per requirement	1
5.2	Ph	IS SP-23 IS 9103	IS 9103	E	QA/E/TP	Minimum 1 sample per month	Minimum 1 sample per month	1

Contd....

Category A: Planning Proforma A-4

Sr. No.	Description Tests/Items	Acceptance Standard	Performance Standard	Performing Agency	Quality Assurance Agency	Frequency of Performance	Frequency of Assurance	Frequency of Audit
5.3	Performance	ASTM C494	ASTM C494	E	QA/E/TP	New source/ As and when required	New source/ As and when required	1
5.4	Records	Project Specification	Project Specification	E/C	QA/E/TP	Daily	Once in a month	1

Storage :

- 1) Admixture shall be stored as per direction of manufacturer in a 10 Ton cylinder horizontal container specially designed to take pressure and to minimise wastage.
- 2) Admixture shall be agitated once in a day and solids if any shall not be allowed to settle.
- 3) Monthly statement of consumption of admixture shall be maintained.
- 4) Total chloride, sulphate content and Ph value of admixture when 4 kg. of admixture is added to 160 kgs. of water shall not exceed permissible limits of chloride, sulphate content and pH value of mixing water calculated separate.

Signed

Date

Signed

Date

Prepared by
(for QA Team)

Approved by
(For Engineer)

Category A: Planning Proforma A-5

TEST FREQUENCY SCHEDULE

Consignment Identification No	Specified Test	Performance Standard	Performing Agency	Quality Assurance Agency	Frequency of Performance	Frequency of Assurance	Frequency of Audit
	a) Chemical Properties						
	b) Physical Properties						
	c) Special Requirements (As specified)						

1) Admixture shall be stored as per direction of manufacturer in a 10 Ton cylinder horizontal container specially designed to take pressure and to minimise wastage.

2) Admixture shall be agitated once in a day and solids if any shall not be allowed to settle.

3) Monthly statement of consumption of admixture shall be maintained.

4) Total chloride, sulphate content and Ph value of admixture when 4 kg. of admixture is added to 160 kgs. of water shall not exceed permissible limits of chloride, sulphate content and pH value of mixing water calculated separate.

Signed

Signed

Date

Date

Prepared by
(for QA Team)Approved by
(For Engineer)

FORMWORK INSPECTION CHECK LIST

LOCATION _____

DATED : _____

 CONTRACTORS INSPECTION REQUEST NO. _____
 CONTRACTORS DRG OR SKETCH NO. _____

YES

NO

N.A.

1. Formwork design/drawing/sketch approved including de-shuttering arrangements
2. Trial panel approved (if required)
3. Formwork alignment correct
4. Formwork levels correct, including screeds
5. Formwork dimensions correct
6. Formwork member spacing correct
7. Formwork member material quality acceptable
8. Falsework member sizes correct
9. False member spacing correct
10. Falsework member material quality acceptable
11. Gaps between primary and secondary members closed/wedged.
12. Face boarding/Plywood/Metal thickness correct
13. Joints between panels closed (no gaps)
14. Joints between panels flush (no steps/lips)
15. Panel flatness acceptable
16. Gaps between secondary members and face panels closed
17. Tie rod material and sizes correct
18. Tie rod spacing correct
19. Tie rods tight, face cones flush
20. Spacers between shutter surface tightly fitting
21. Box outs, cast-in items, ducts fixed correct, securely
22. Prestressing sheathing and vents, alignments and spacing of supports acceptable



IRC:SP:57-2000

Category B: Inspection Proforma B-2

23. Empty sheathing secured against flotation
24. Prestressing anchorage positions and fixing acceptable
25. Chamfers/fillets sizes, straightness, fixing acceptable
26. Formwork clean
27. Formwork release oil material approved
28. Formwork release oil applied correctly
29. Contraction joint preparation satisfactory
30. Contraction/expansion joint preparation satisfactory
31. Safe access constructed
32. Adequate work space provided for labour, equipment
33. Shutter vibrators (if required) location and fixing arrangements approved

Inspected by :
(for Contractor)

Name

Signed

Date

Approved by :
(for Department)

Name

Signed

Date

REINFORCEMENT INSPECTION CHECK LIST

LOCATION

DATED :

 CONTRACTORS INSPECTION REQUEST NO.
 REF. DRG. NO.

YES

NO

N.A.

1. Working drawing checked and approved
2. Latest revision being used
3. Bar schedules approved
4. Reinforcing steel material approved
5. Bar bending and cutting satisfactory
6. Corrosion treatment of bars, if required, satisfactory
7. Bar sizes correct
8. Bar spacing correct
9. Bar lap lengths correct
10. Bar laps at correct locations
11. Bar tied as specified
12. Bar assembly rigid and adequately Supported (including spacers/chain supports)
13. Cover to bottom bars correct
14. Cover to side bars correct
15. Cover to top bars correct
16. Cover blocks approved including fixing

 Inspected by:
 (for Contractor)

Name

Signature

Date

 Approved by:
 (for Department)

Name

Signature

Date

INSPECTION CHECK LIST BEFORE APPROVAL TO CONCRETE

LOCATION

DATED :

CONTRACTORS INSPECTION REQUEST NO.

YES/NO

1. Method statement approved
2. Batching plant mixers in working order (Separate dispenser for admixture, if required available)
3. Standby batcher in working order
4. Water, sand coarse aggregate, cement, admixture, cement approved
5. Water, sand coarse aggregate, cement, admixture, cement stock sufficient
6. Concrete conveying arrangement (including transit mixers) Available in working condition and of sufficient capacity
7. Formwork approved
8. Reinforcement approved
9. Prestressing sheathing approved
10. Concreting equipment in working order
11. Standby crane, vibrators present
12. Tremie in working order (for under water work)
13. Concrete gang present, including carpenter, steel fixer, mechanics and electricians
14. Access provided
15. Safety arrangements adequate
16. Lighting provided
17. Communications between various points provided
18. Arrangements for arranging suspension/stoppage of concrete provided
19. Curing arrangements made
20. Laboratory notified

Inspected by:
(for Contractor)

Name

Signature

Date

Approved by:
(for Department)

Name

Signature

Date

CONCRETE DELIVERY AND POUR RECORD**1. CONCRETE BATCHING DELIVERY TICKET NO.**

Location of Pour	:	Date	:
Concrete Grade	:	Mix. Temp.	:
W/C Ratio	:	Slump	:
Cement contents	:	No. of cubes taken	:
Max. Aggregate size	:		
Admixture (Type & Dosage)	:		
Batching started, Hrs.	:	Batching Finishing, Hrs.	:
Quantity Batched, Cum.	:	Truck No.	:

2. TRUCK ARRIVED ON SITE

		Hrs.	
Stump Test Result(s)	:	mm at	Hrs.
Discharge started	:	Hrs.	
No. of sitecubes taken	:	Hrs.	
Place where cubes taken	:	Hrs.	
Placement temperature of concrete	:		
Ambient Temp.	:		
Weather condition	:		

Inspected by : (for Contractor)	Name :	Signed	Date
Approved by : (for Department)	Name :	Signed	Date

Category B: Inspection Proforma B-6

POST CONCRETING INSPECTION

Note : Post concreting inspection shall be carried at various stages, such as, after stripping of side shuttering each stage of prestressing, decentering and/or as per designers stipulation.

Location :

Stage of inspection :

Date of Pour :

Date of inspection :

S or NS*

Observation		Type of Remark S or NS*	
1.	Position/Dimensions : of the member	Alignment	S or NS
		Levels	S or NS
		Dimensions	S or NS
2.	Surface Defects (honey : combing/sand streaks/ air bubbles/cold joints)	No defects Minor defects Major defects	(Note type and extent of defect)
3.	Class of Finish :	S or NS	
4.	Cracks :	No cracks	Date first observed:
		Cracks	
		Nature of cracks	
5.	Any other Defect :		
6.	Non-conformance report no. :	Report no./ Not applicable	

Remarks:

In case of NS report in items (1) to (5), it should be examined by competent authority before approval or non-approval. If required, a separate non-conformance report (including sketches, photographs, etc.) shall be prepared for further action.

* S= Satisfactory, NS= Not satisfactory

Inspected by: (for Contractor)	Name	Signature	Date
Approved by: (for Department)	Name	Signature	Date
Approval/Non-Approval by: (for Department)	Name	Signature	Date

AGGREGATE IMPACT VALUE - AIV

Location :			Tested by:			
Material :			Date :			
Quarry No. :			Range of Sieve : 10.0 to 12.5 mm			
Date Sample :			No. of Blows : 15			
Location :			Height of Fall : 380 mm			
Method of Sampling : By means of scoop			Method of Crushing : Sudden			
Sample No.	1 Wt. Container Grms.	2 Wt. Container + Aggregate Grms.	3 Wt. Aggregate before compaction Grms. (2-1)	4 Wt. Aggregate retained on 2.36 mm sieve Grms. -	5 Wt. Aggregate passing on 2.36 mm sieve Grms. (3-4)	6 Aggregate Impact value % (5/3) x 100
REMARKS :					AVERAGE : %	
<div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="width: 45%;">CLIENT'S REPRESENTATIVE</div> <div style="width: 45%;">CONTRACTOR'S REPRESENTATIVE</div> </div>						

Category B: Inspection Proformae B-8

FIELD DENSITY TEST CORE CUTTER METHOD

Location :

Tested by:

Material :

Date :

Reduced level :

Bulk Density :

gm/cc.

Layer No.

Layer Thickness

MDD =

OMC =

gm/cc

%

No.	CHAINAGE	U	1	2	3	4	5
1.	Mass of mould+ Compacted soil	Gms.					
2.	Mass of mould	Gms.					
3.	Mass of Compacted soil (2-1)	Gms.					
4.	Volume of mould	CC					
5.	Wet Density of soil (3/4)	Gms./CC					
	Moisture Determination	-	-	-	-	-	-
6.	Wt. Wet soil +	Gms.					
7.	Wt. Dry soil +	Gms.					
8.	Wt. Water (6) – (7)	Gms.					
9.	Moisture content (8)/(7)x100	%					
10.	Field Dry density of soil (5)/1+(9)/100	Gms./CC					
	Degree of compaction (10/MDD X 100)	%					

Average degree of Compaction :

Standard Deviation :

REMARKS :

CLIENT'S REPRESENTATIVE

CONTRACTOR'S REPRESENTATIVE

FLAKINESS INDEX TEST				
Location :			Tested by :	
Material :			Date :	
Sieve Range (MM)	1 Total weight of Aggregates Grms.	2 Wt. Aggregate retained Grms.	3 Wt. Aggregate passing Grms.	4 Flakiness Index (%) Grms.
63-50				
50-40				
40-31.50				
31.50-25				
25-20				
20-16				
16-12.50				
12.5-10				
10-6.3				
REMARKS:				Average : %
CLIENT'S REPRESENTATIVE			CONTRACTOR'S REPRESENTATIVE	



Rv/IRC/10i

IRC:SP:57-2000

Category B: Inspection Proformae B-10

ATTERBERG LIMIT

LOCATION :

SOURCE :

MATERIAL :

TESTED BY :

DATE :

SAMPLE NO. :

DETERMINATION NO.	UNIT	LIQUID LIMIT (LL)				PLASTIC LIMIT (PL)		
		1	2	3	4	1	2	3
No. of Blows/Penetration in mm								
CONTAINER NO.								
1. Wt. Container+Wet. soil	Gms.							
2. Wt. Container+Dry soil	Gms.							
3. Wt. Water (1)-(2)	Gms.							
4. Wt. Container	Gms.							
5. Wt. Dry Soil (2-4)	Gms.							
6. Moisture Content(w) 3/5x100	Gms.							

Moisture content (%)

No. of Blows

LL %

PL %

Plastic Index (PI) %

Remarks

CLIENT'S REPRESENTATIVE

CONTRACTOR'S REPRESENTATIVE

COMPACTION TEST MODIFIED PROCTOR

LOCATION :

TESTED BY :

SOURCE :

DATE :

MATERIAL :

SAMPLE NO. :

WET DENSITY

DETERMINATION	UNIT	1	2	3	4	5	6
1. Wt. Mould+Compacted soil	Gms.						
2. Wt. Mould	Gms.						
3. Wt. Compacted Soil (1-2)	Gms.						
4. Volume of Mould	Gms.						
5. Wet Density (3/4)	Gms./CC						
6. Moisture Content(w)	%						
7. Dry Density (5/1+W)/100	Gms./CC						

Dry Density (Gm/CC)				
Moisture Content (%)				

MAXIMUM DRY DENSITY (MDD):

Gms/CC

Optimum Moisture Content (OMC)

%

Remarks

CLIENT'S REPRESENTATIVE

CONTRACTOR'S REPRESENTATIVE

Category B: Inspection Proformae B-12

FIELD DENSITY TEST BY SAND REPLACEMENT METHOD

LOCATION :

TESTED BY :

SOURCE :

DATE :

MATERIAL :

RL:

(O) BULK DENSITY : Grm./ CC

LAYER THICKNESS : MM

OMC: %

(14) MDD : Grm./CC

SAMPLE NO.		1	2	3	4	5
1. Wt. Sand before Pouring	Grs.					
2. Wt. Sand after Pouring	Grs.					
3. Wt. Sand in Hole+Cone(1-2)	Grs.					
4. Wt. Sand in Cone	Grs.					
5. Wt. Sand in Hole (3-4)	Grs.					
6. Volume of Hole(5/0)	CC					
7. Wt. Wet Soil from Hole	Grs.					
8. Wet Density of Soil (7/6)	Grm./CC					
Moisture Determination						
9. Wt. Wet Soil+	Grm.					
10. Wt. Dry Soil+	Grm.					
11. Wt. Water (9-10)	Grm.					
12. Moisture Content 11/10x100	%					
13. Field Dry Density	Grm./CC					
DEGREE OF COMPACTION (13/14)100						
<div style="display: flex; justify-content: space-between;"> <div>REMARKS:</div> <div>AVERAGE DEGREE OF COMPACTION : %</div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div>CLIENT'S REPRESENTATIVE</div> <div>CONTRACTOR'S REPRESENTATIVE</div> </div>						

CBR (SOAKED/UNSOAKED)

LOCATION :

TESTED BY:

SOURCE :

DATE OF MOULDING:

MATERIAL :

DATE OF TESTING :

SAMPLE NO.:

DESCRIPTION OF SOIL:

MOULD NO.

1.	Weight	:	Grms.
2.	Volume	:	CC
Sourcharge Wt. Used :		:	Grms.

WET DENSITY

3.	Wt. Mould+Wet Comp. Soil	Grm	
4.	Wt. Wet Compacted Soil (3-1)	Grm	
5.	Wet Density (4/2)	G/cc	

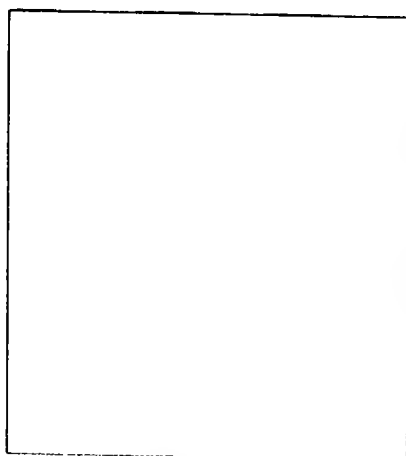
NO. OF	BLOWS	LAYERS
Modified PROCTOR	MDD: OMC:	Gm/CC %

MOISTURE CONTENT

*	Container No.	*	E
6.	Wt. Container+Dry Soil	Grm	
7.	Wt. Container+Dry Soil	Grm	
8.	Wt. Water (6-7)	Grm	
9.	Wt. Container	Grm	
10.	Wt. Dry Soil (7-9)	Grm	
11.	Moisture Content (8/10)x100	%	
DRY DENSITY (5/1+11)X100		G/CC	

SWELLING TEST

DATE	TIME	DAYS	READING		Swell (mm)	Swell (%)
			I	F		

STRESS (kg./Cm²)

PENETRATION (MM)	TIME Min./Sec	LOAD kg	STRESS kg/Cm ²	CORRECTED LOAD (KG)

PENETRATION (MM)

CBR (2.5)

CBR (5.0)

Category B: Inspection Proforma B-14

BITUMEN EXTRACTION

LOCATION

DATE SAMPLED :

DATE TESTED:

SAMPLE NO.	UNIT	1	2	3	4	5	6
1. Wt. of Sample +Bowl	Gms.						
2. Wt. of Bowl	Gms.						
3. Wt. of Sample	Gms.						
4. Wt. of Filter paper before extraction	Gms.						
5. Wt. of Filter paper after extraction	Gms.						
6. Wt. of filter on filter paper	Gms.						
7. Wt. of aggregate+bowl after extraction	Gms.						
8. Wt. of washed (7-2+6) aggregate	Gms.						
9. Wt. of bitumen (3-8)	Gms.						
10. Binder content (9/3)	%						

REMARKS

CLIENT'S REPRESENTATIVE

CONTRACTOR'S REPRESENTATIVE

MARSHAL TEST

LOCATION :

DATE SAMPLED :

DATE TESTED

Material Description : D.B.M./A.C.

<i>Density Determination</i>	Marshal	JMF dens.					
SAMPLE NO.	UNIT	1	2	3	4	5	6
1. Wt. in Air	Gms.						
2. Wt. in Air SSD	Gms.						
3. Wt. in Water	Gms.						
4. Volume	Gms.						
5. Density	Gms./CC						
6. Air Voids in Mix	3-5% *						
7. VMA	8-22% *						
8. Stability	820 kg *						
9. Flow	2-4 mm *						
REMARKS							
<div style="display: flex; justify-content: space-between; margin-top: 100px;"> <div>CLIENT'S REPRESENTATIVE</div> <div>CONTRACTOR'S REPRESENTATIVE</div> </div>							

* Denotes permissible values

Category B: Inspection Proforma B-16

CORE TEST

LOCATION:

DATE SAMPLED :

DATE TESTED :

Material Description : D.B.M./A.C.

Density Determination	Core	JMF dens.					
SAMPLE NO.	UNIT	1	2	3	4	5	6
1. Core no.							
2. Core Chainage							
3. Core Thickness	mm						
4. Wt. in Air	Gms.						
5. Wt. in Water	Gms.						
6. Volume	Gms.						
7. Density	Gms/CC						
8. Compaction (Core)	%						
REMARKS							
CLIENT'S REPRESENTATIVE				CONTRACTOR'S REPRESENTATIVE			

* JMF : Job Mix Formula

GRADATION/AC

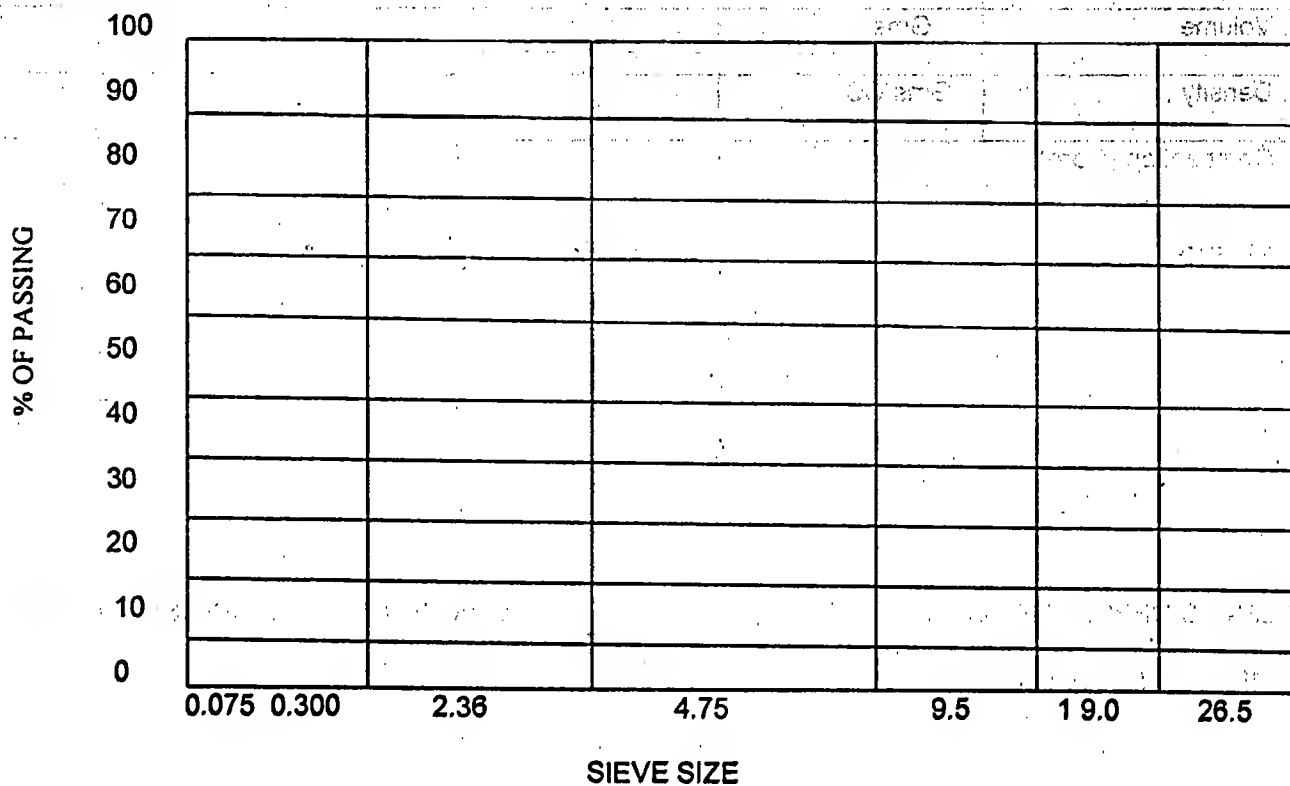
LOCATION :

DATE SAMPLED :

DATE TESTED :

Material Description : AC

IS SIEVE	WT.RETAINED GMS	% RETAINED	% COMULATIVE RETAINED	%CUMULATIVE PASSING		
				ACTUAL	DESIGN Example*	LIMIT
26.5					100	100
19					100	90 - 100
9.5					71.2	56 - 80
4.75					45	35 - 65
2.36					34.1	23 - 49
0.3					11	5 - 19
0.075					32	2 - 8



CLIENT'S REPRESENTATIVE

CONTRACTOR'S REPRESENTATIVE

AC: Asphaltic Concrete

* User to fill his design parameters

Category B: Inspection Proforma B-18

GRADATION/DBM

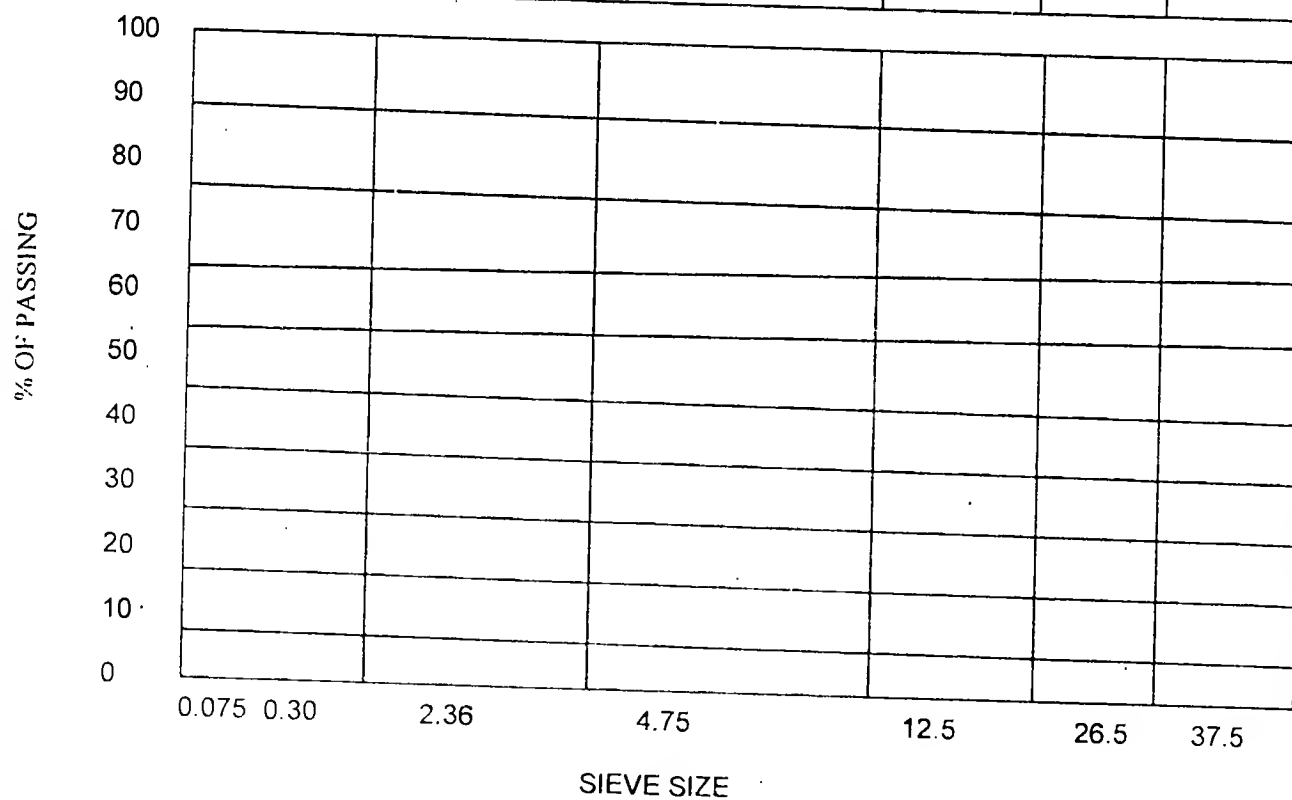
LOCATION

DATE SAMPLED :

DATE TESTED:

Material Description : DBM

IS SIEVE	WT.RETAINED GMS	% RETAINED	% COMULATIVE RETAINED	%CUMULATIVE PASSING		
				ACTUAL	DESIGN SAMPLE*	LIMIT
37.5					100	100
26.5					100	90 - 100
12.5					64.1	56 - 80
4.75					39.1	29 - 59
2.36					29.7	19 - 45
0.3					9.6	5 - 17
0.75					2.5	1 - 7



CLIENT'S REPRESENTATIVE

CONTRACTOR'S REPRESENTATIVE

DMB : Dense Bituminous Macadam

* User to fill his design parameters

CALIBRATION CHART OF BATCHING PLANT FOR AGGREGATE GUAGE

CALIBRATED DATE :-

LOAD APPLIED (KG)	DIAL GAUGE READINGS						AVERAGE
	TRIAL-1		TRIAL-2		TRIAL-3		
	LOADING	UNLOADING	LOADING	UNLOADING	LOADING	UNLOADING	
0							
50							
100							
150							
200							
250							
300							
350							
400							
450							
500							
550							
600							
650							
700							
750							
800							
850							
900							
950							
1000							
1050							
1100							
1150							

REMARKS :

CLIENT'S REPRESENTATIVE

CONTRACTOR'S REPRESENTATIVE

Category C: Calibration Proformae C-2

CALIBRATION CHART OF BATCHING PLANT FOR WATER METER

CALIBRATED DATE :-

SL. NO.	TRIAL-1		TRIAL-2		TRIAL-3		AVERAGE
	METRE READING (LTRS)	WATER MEASURED (LTRS)	METRE READING (LTRS)	WATER MEASURED (LTRS)	METRE READING (LTRS)	WATER MEASURED (LTRS)	
1	10		10		10		
2	20		20		20		
3	30		30		30		
4	40		40		40		
5	50		50		50		
6	60		60		60		
7	70		70		70		
8	80		80		80		
9	90		90		90		
10	100		100		100		
11	110		110		110		
12	120		120		120		
13	130		130		130		
14	140		140		140		
15	150		150		150		

REMARKS :

CLIENT'S REPRESENTATIVE

CONTRACTOR'S REPRESENTATIVE



Category C: Calibration Proforma C-4

CALIBRATION REPORT
(Cube Testing Machine)

DATE OF CALIBRATION

TEMP.

GAUGE NO.

CAPACITY

EQUIPMENT

MODEL

FORCE MEASURING DEVICE

SL. NO.

CERTIFIED BY

PLACE

REF.

SL.NO.	DEFLECTION IN DIAL GAUGE IN PROVING RING	ACTUAL LOAD APPLIED KN	AVERAGE OF THREE READING	INDICATED LOAD ON GAUGE ERROR
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

NOTE : To obtain correct result positive (+) error to be subtracted, negative (-) error to be added to the indicated load readings on machine gauges.

CLIENT'S REPRESENTATIVE

CONTRACTOR'S REPRESENTATIVE

MATERIAL QUALITY SURVEILLANCE FORM

CONTRACTOR			CONTRACT NO.	
MANUFACTURER	SUPPLIER	SOURCE	PURCHASE ORDER	INSPECTING AGENCY

INSPECTED AT	INSPECTION CERTIFICATE	DELIVERY CHALLAN	DISTINGUISHING MARK	DATE OF MFR./ SUPPLY
--------------	------------------------	------------------	---------------------	----------------------

SHIPPING, STORAGE & OTHER REMARKS	(Satisfactory/ No satisfactory)
-----------------------------------	------------------------------------

TEST RECORD

S.NO.	Test	Method of Test	Acceptance Limits & Units	Obtained Value	Remarks
-------	------	----------------	---------------------------	----------------	---------

(Appropriate Tests)

Remarks:

Inspected by:
(for QA Team)

Name

Signature

Date

in presence of
(for Contractor)

Name

Signature

Date

Category D: Surveillance Proformae D-2

PRODUCTS QUALITY SURVEILLANCE FORM

NAME OF PRODUCT:

CONTRACTOR

CONTRACT NO.

MANUFACTURER/SUPPLIER/SOURCE

PURCHASE
ORDERINSPECTING
AGENCYINSPECTION
CERTIFICATEDELIVERY
CHALLANDISTINGUISHING
MARKDATE
OF MFR./
SUPPLY

Drawing Nos.

Tender Specification Clause

SHIPPING,
STORAGE &
OTHER REMARKS

S.No.	Test	Method of Test	Acceptance Limits & Units	Obtained Value	Remarks

Inspected by :
(for QA Team)

Name

Signature

Date

In presence of
(for Contractor)

Name

Signature

Date

SURVEILLANCE FORM FOR PRE-CONCRETING OPERATIONS

CONTRACTOR	CONTRACT NO.
ELEMENTS OF STRUCTURE	IDENTIFICATION NO. LOCATION

SURVEILLANCE OBSERVATIONS

WORK DESCRIPTION

1. Line, level and dimension as per drg.

2. Availability of adequate approved material

3. Placing of reinforcement
(including supports/spacers, etc.)

4. Formworks and scaffolding as per drawing

5. Box outs/embedded parts, if any

6. Cleaning of forms

7. Arrangement of plant and equipment

8. Walkway for pouring and inspections

9. Safety arrangement

10. Curing arrangement

Inspected by : (for QA Team)	Name	Signature	Date
---------------------------------	------	-----------	------

In presence of (for Contractor)	Name	Signature	Date
------------------------------------	------	-----------	------

QUALITY SURVEILLANCE FORM FOR WORKMANSHIP OF CONCRETE

CONTRACTOR	CONTRACT NO.
ELEMENTS OF STRUCTURE	LOCATION

SURVEILLANCE OBSERVATIONS

The following items should be observed during concrete pour by the QA Surveillance Team

- 1) **Mixing of Concrete:**
 Check the concrete class and the respective mix design already approved.
 Check the condition of the aggregates to be used.
 Check the weighing and water dispensing method adopted during the mixing.
 Check that the mixer machine has been cleaned properly.
 Check that the required mixing time is allowed.
- 2) **Transportation/Conveyance (as Specified, but generally to cover following):**
 Check if the equipment is in proper working order.
 Check if the specified methods are being followed.
 Check if the stipulated time limits are observed.
 Check if the non-conforming wet concrete is being rejected and disposed off.
- 3) **Placing of Concrete**
 Check that:
 The concrete is not segregated during pour. The height of dropping is controlled.
 The concrete is poured in layers.
 The vibrators are being applied systematically to compact uniformly and adequately, avoiding over vibration.
 The concrete is not being pulled or pushed. Pouring is being done close to the final position.
 The cold joints are not allowed to be developed.
 The under water concrete is being poured only by tremies or pipeline.
 The forms are not getting displaced or deformed during the concrete pour and vibrating.
 No cement slurry is getting lost. Suitable number of carpenters are present to watch and repair formwork during the pour, if required.
 The concrete is poured within the allowable time limits from the time of batching.
 The concrete cubes are taken as required.
 The curing arrangements are satisfactory.
 The equipment is in working condition.
 The equipment is cleaned properly.
 The quality of wet concrete is as per specifications, (slump, homogenous mix etc.)
 Continuous supply of concrete is assured

Inspected by : (for QA Team)	Name	Signature	Date
In presence of (for Contractor)	Name	Signature	Date

SURVEILLANCE FORM FOR PAVEMENT LAYERS

SURVEILLANCE OBSERVATIONS

PAVEMENT LAYER DESIGNATION	LAYER NO./REQUIRED LEVEL	LOCATION
Materials/Workmanship Earth works/Granular sub-base 1. Check material is from approved borrow 2. Free from roots and other perishable material 3. Grading is acceptable 4. Spread layer thickness is acceptable 5. Moisture is near optimum prior to compaction 6. Lines/levels are within tolerance Equipments Check 1. Adequate for the work 2. In condition	Wet mix macadam 1. Conforms to job mix formula 2. Free from deleterious materials 3. Spread layer thickness is acceptable 4. Moisture is near optimum prior to compaction 5. No segregation during transport 6. No segregation during paving 7. Lines and levels within tolerance Equipments 1. Adequate for the work 2. In condition	Asphalt 1. Conforms to job mix formula 2. Free from deleterious material 3. Spread layer thickness is acceptable 4. Temperature at break down rolling is within specs 5. No segregation during transport 6. No segregation during paving 7. Lines and levels within tolerance Equipments 1. Adequate for the work 2. In condition

Inspected by : (for QA Team)	Name	Signature	Date
---------------------------------	------	-----------	------

In presence of	Name	Signature	Date
----------------	------	-----------	------

Category E: Proformae for Registers & Records E-1

PARTICULARS OF WORK

Name of Work _____

Name of Contractor _____

Address of Contractor _____

Contract agreement no. _____

Contract Amount _____

Application Schedule of Rates _____

Period of Completion _____

Date of Work Order _____

Stipulated Date of Completion _____

Actual Date of Starting of Work _____

Extensions _____

(1) _____

(2) _____

INCUMBENCY

SR. NO.	DESIGNATION*	NAME	PERIOD	
			FROM	TO

* Departmental officers designations covering all officers having execution responsibilities for the project.

Category E: Proforma for Registers and Records E-2

REGISTER OF DRAWINGS

Name of work

Name of Contractor

1. Receipt of drawings

Sr. No.	Drawing No./Date	Revision No.	Brief Title	Issued by/ (Source)	Date of Receipt	No. of copies	Status of Drg.	Further Action	Signature and date

2. Issue of drawings

Sr. No.	Drawing No./Date	Revision No.	Brief Title	Sr. No. of Receipt Register	Issued to	No. of Copies	Status of Drg.	Drawing supersedes Drg. No. (if any)	Signature and date

Category E: Proforma for Registers and Records E-4

CONSUMPTION OF CEMENT ON DIFFERENT ITEMS OF WORKS (THEORETICAL AND ACTUAL)

Name of work :
Name of Contractor :

(A) Weekly Record of items of works

Sr. No.	Item of work	Quantity of work done during the week

(B) Abstract for the week ending... (Indicate Cement Consumption)

Sr. No.	Item of Work	Quantity of work done		Rate of Cement per unit (Bags/MT)	Cement required to be consumed theoretically (Bags/MT)	Actual cement consumption (Bags/MT)
		Quantity	Unit			

For Contractor

Name

Date

For Engineer

Name :

Signed

Date

Category E: Proforma for Registers and Records E-5

RECORDS OF CALIBRATION OF EQUIPMENT

Name of Work :

Name of Contractor :

ITEM	DATE CALIBRATED & PERSON CERTIFYING (FOR VENDOR OR CONTRACTOR)	*DATE OF NEXT CALIBRATION	DATE OF INSPECTION & PERSON APPROVING (FOR DEPARTMENT)	RESULT OF INSPECTION

* Frequency of calibration for different equipment to be specified in advance.

Category E: Proforma for Registers and Records E-6

DAILY PROGRESS REPORT

Name of work :

Name of Contractor :

Date	Activity location	Item of work	Weather condition	Special problems/ difficulties	Remarks	Signature with Date	
						Recorded	Checked

For Contractor

Name :

Signed

Date

For Engineer

Name :

Signed

Date

REGISTER OF INSPECTION NOTES

Name of work :

Name of Contractor :

No. of Inspection Note	No. and Date under which received	Reviewed by	Signature	No. and date of compliance submitted	Reviewed by	Signature	Remarks

For Contractor

Name :

Signed

For Engineer

Name :

Signed

Date

Date

REGISTER OF OBSERVATIONS MEMOS ISSUED FROM THE QUALITY CONTROL CELL

Name of work :

Name of Contractor :

Year	Observation Memo No.	No. & Date under which It is received	Reviewed by	Signature	No. and date of compliance submitted	Reviewed by	Signature	Remarks

BITUMEN REGISTER

1. Weekly Receipt/Issue (For week from _____ to _____)

Name of Work :

Name of Contractor :

Closing Balance at the Site of Work from :

Previous week _____ MT/Packs

Date	Quantity Received		Source	Quantity used MT	Purpose	Closing balance at the end of day (Packs/MT)
	MT	Grade				
Total						

For Contractor

For Engineer

Name :

Name :

Signed :

Signed :

Date :

Date :

GUIDELINES FOR NON-CONFORMING WORKS

1. General

In broad terms, for the Quality Assurance of the finished work it is necessary for the materials and workmanship to conform with the Contract requirements. Ideally, non-conforming work shall be rejected.

The statement above is true in general terms, but special difficulties arise in the case of concrete, where the non-conformance may only be known after 28 days cube results become available, in which period work has progressed further. In some of the situations, acceptance after repair/review for adequacy is feasible. Therefore, separate procedures are laid out for some of the non-conforming situations. In case the feasible items do not meet the requirements after such repair/review, the non-conforming item should be rejected.

2. Concrete/Asphalt Work

The primary means by which Quality Assurance shall be achieved is by the procedures described in relevant material qualification and workmanship method statement. The non-conforming concrete/asphalt items shall be further reviewed, as given below:

2.1. Non-Conformance other than Strength or Finish

In the event that any requirement other than strength and standard of finish is not met, then the following procedure shall be followed:

1. The contractor shall be notified without delay verbally, and in writing by the following means:
 - (a) Return of the request for Inspection Form signed "not approved" with the reason for rejection stated.
 - (b) Issue of a Site Instruction or Site Works Order or letter stating the facts and confirming that the works are not approved.

2. Approval to carryout concreting/asphalting of a similar nature shall be withheld.
3. The Contractor shall be asked for his proposals to rectify the non-compliance, which may involve re-submission of materials, new trial mixes, revised method statement.
4. The acceptance or rejection of any unapproved concrete/asphalt work shall be referred to the Engineer.
5. When satisfied with the measures taken to ensure future compliance, the Engineer shall confirm approval to continue concrete/asphalt for permanent works.

2.2. **Non-Conformance with Strength Requirements**

1. The specification strength/density for concrete/asphalt recognises the statistical possibility of cube failures and thus limits of means, standard deviation, minimum values of strength are specified. The rejection criteria is set out in the agreement.
2. In the event of cube/density failures outside the provision of the Contract then the non-compliance procedures described in the specification shall be followed:
 - (a) Approval of concreting/asphalting of similar works shall be withheld.
 - (b) All aspects of concreting/asphalting shall be reviewed.
 - (c) The cause of failure shall be identified and measures taken to remedy the problem.
3. Various repair/rectification procedures for commonly arising/non-conformance are specified in contract. The contractor shall furnish his exact proposals for rectification under consideration.
4. The fact of non-conformance and the proposed rectification procedure is conveyed to the engineer/design organization of owner (or design consultant) for review and opinion about:
 - (i) Acceptability of measure proposed by the contractor, if any.
 - (ii) Further non-destructive testing, if any.
 - (iii) Acceptability in case strength is achieved at a later age (e.g., 90 days)
 - (iv) Acceptability at the level of strength achieved for the stress levels in concerned members.

- (v) Acceptance of repair/rectification/strengthening measures with modifications, if required, or rejection.
- 5. Rejection in case the item does not pass modified acceptance limits after repairs.
- 2.3. Non-Conformance with Finish Requirements**
 - 1. Where the required finish is non-attained then the non-conformance procedure for repair/rectification as described in the Specification shall be followed.
 - 2. In addition, the following procedures shall be followed:
 - (a) Approval of similar work shall be withheld.
 - (b) All aspects of work shall be reviewed.
 - (c) The cause of poor finish shall be identified.
 - 3. Revised specifications/instructions to avoid further recurrence of non-conformance shall be issued.
- 2.3.1. Non-conformance in case of earthworks, base and other pavement coarse can be treated as per guidelines under Section 2.1, 2.2, and 2.3 as applicable.

3. Records

- 1. It is mandatory that all instances of work outside the specification are recorded in writing and conveyed to the contractor. This ensures that:
 - (a) The contractor is irrefutably informed.
 - (b) A record of non-compliance is built up to give a general guide to the contractor's performance.
- 2. The records of repair/rectification, retesting, inspection and acceptance shall be kept as part of 'as-built' documentation.
- 3. Record of all references to designers for concessions/rectification and approval given by them shall be kept.
- 4. Record of compliance to the modifications in procedures, testing, etc., if any shall be kept.

QUALITY AUDITS

1. Programme

The Quality Assurance Manager shall establish, document and implement a programme for audits which shall objectively evaluate the adequacy of the functions, systems and procedures as referenced in the Quality Manual.

The audit programme shall define:

1. The functions, systems and procedures to be audited.
2. Personnel qualified to perform audits.
3. Frequency of audits.
4. Method of reporting findings and recommendations.
5. The means for having corrective actions agreed upon and implemented.

Audit shall include an evaluation of process audit and product audit.

1. Quality practices, systems, procedures and instructions.
2. Certification documents and records.
3. Quality of (intermediate or) end product.

Audit shall be carried out by appropriately trained personnel who are not directly responsible for the area being audited.

Audits shall be performed in accordance with documented audit procedures and/or check-lists which identify essential characteristics.

Management responsible for the area audited shall review, agree and correct deficiencies revealed in the documented audited results.

All action taken to correct deficiencies shall be re-audited to verify compliance and a close-out report issued.

2. Example of Quality Audit Report

The scope and depth of the Quality Audits shall be determined by the Quality Assurance Team responsible to the Management. The procedures for quality audit of concrete, asphalt and wet mix macadam are given below for illustrating the principles.

3. Quality Audit of Quality Systems

A modern technique for assessment of the index of quality of work, which is based on collectively evaluating the overall quality of work, has been in vogue recently on certain projects and it enables qualifying quality index. For each of the important item of work, certain attributes are listed which contribute or affect the work quality of that item. Individual scores are then assigned to each of these attributes on a scale of 0 to 5 depending on observations and scrutiny of that attribute of that site. The sum total of the scores of all attributes for particular item divided by maximum score achievable is termed as quality index of that item. Generally, quality index of 66 per cent and above may be accepted, but a score below that should call for detailed scrutiny and investigation about the causes of lower quality index to enable necessary remedial measures.

It has to be noted that this index is only an adhoc yard stick to serve as a guide to gauge the extent of Quality Assurance System being exercised at site. It is not to be related to any acceptance criteria or payment to be made.

As this is relatively a new concept, it may be necessary to periodically review the list of attributes and their relative weightages for measuring the quality index from time to time after gaining actual experience for some time.

TABLE (E-2)-1**TABLE FOR QUALITY GRADING FOR CONCRETE CONSTRUCTION**

Sr. No.	Item/Factor	* Factor	SCORE					
			5	4	3	2	1	0
1.	QA/QC System/Service available*	A	5	4	3	2	1	0
2.	Storage of Cement*	A	5	4	3	2	1	0
3.	Type and Storage of aggregates	B	-	-	3	2	1	0
4.	Water used Quality*	A	5	4	3	2	1	0
5.	Use of admixtures	B	-	-	3	2	1	0
6.	Type and use of machinery	B	-	-	3	2	1	0
7.	Training of personnel and *level of awareness	A	5	4	3	2	1	0
8.	Client Supervision QTY+Qlty	B	-	-	3	2	1	0
9.	Workability of Concrete*	A	5	4	3	2	1	0
10.	Control and checks on W/C ratio*	A	5	4	3	2	1	0
11.	Sequence of loading in mixer (for tilting mixers)	B	-	-	3	2	1	0
12.	Transport and placing time lag, tools, equipment, ski	A	5	4	3	2	1	0
13.	Formwork design Accuracy*	A	5	4	3	2	1	0
14.	Formwork-Water tightness*	A	5	4	3	2	1	0
15.	Formwork- Release agent	B	-	-	3	2	1	0
16.	Formwork-Sequence of release	B	-	-	3	2	1	0
17.	Reinforcement: Type and testing	B	-	-	3	2	1	0
18.	Reinforcement: Storage & Fabrication	B	-	-	3	2	1	0
19.	Reinforcement placing and cover blocks*	A	5	4	3	2	1	0
20.	Reinforcement congestion-detailing	A	5	4	3	2	1	0
21.	Construction joints type- execution*	A	5	4	3	2	1	0
22.	Finishing of concrete-tools	B	-	-	3	2	1	0
23.	Finishing of concrete materials*	A	5	4	3	2	1	0
24.	Curing method*	A	5	4	3	2	1	0
25.	Curing Time	B	-	-	3	2	1	0
26.	Surface blemishes*	A	5	4	3	2	1	0
27.	Dimesion and profile of finished concrete	B	-	-	3	2	1	0
28.	Testing of concrete frequency.	B	-	-	3	2	1	0
29.	Hot weather concreting precaution*	A	5	4	3	2	1	0
30.	Provision for maintenance of concrete surface.	B	-	-	3	2	1	0

* Factor A are graded on a scale of 0 to 5 while Factor B are graded on scale of 0 to 3 and total score is worked out for a given job on its inspection.

* Factor A-Max. score 80 (16 x 5)

Total: Max. 122

* Factor B-Max. score 42 (14 x 3)

Acceptable concrete to score

Total 80/122

55 on Factor A and

25 on Factors B

TABLE (E-2)-2**ILLUSTRATIVE TABLE FOR QUALITY GRADING FOR ASPHALTIC WORKS**

Sr. No.	Item/Factor	* Factor	SCORE					
			5	4	3	2	1	0
1.	QA/QC System/Service available*	A	5	4	3	2	1	0
2.	Storage of Bitumen*	A	5	4	3	2	1	0
3.	Type and Storage of aggregates	A	5	4	3	2	1	0
4.	Q/C for aggregate production	A	5	4	3	2	1	0
5.	Type of Hot mix plant	A	5	4	3	2	1	0
6.	Hot mix plant laboratory	B	-	-	3	2	1	0
7.	Environmental friendliness of plant	A	5	4	3	2	1	0
8.	Control/checks on binder	A	5	4	3	2	1	0
9.	Temperature control	A	5	4	3	2	1	0
10.	Grading of mixed asphalt	A	5	4	3	2	1	0
11.	Communication facilities	B	-	-	3	2	1	0
12.	Safe storage of fuel	B	-	-	3	2	1	0
13.	General safety	B	-	-	3	2	1	0
14.	Client's supervision Qty. + Quality	B	-	-	3	2	1	0
15.	Transportation network	A	-	-	3	2	1	0
16.	Paving/Paving Temp./Quality	A	5	4	3	2	1	0
17.	Compaction	A	5	4	3	2	1	0
18.	Final asphaltic profile	A	5	4	3	2	1	0
19.	Surface quality	A	5	4	3	2	1	0
20.	Skill of operatives	A	5	4	3	2	1	0

* Factor A are graded on a scale of 0 to 5 while Factor B are graded on scale of 0 to 3 and total score is worked out for a given job on its inspection.

* Factor A-Max. score ($15 \times 5 = 75$)

Total: Max.90

* Factor B-Max. score ($5 \times 3 = 15$)

Acceptable score
51 on Factor A and
9 on Factor B

Total 60/90

TABLE (E-2)-3**ILLUSTRATIVE TABLE FOR QUALITY GRADING – WET MIX MACADAM**

Sr. No.	Item/Factor	* Factor	SCORE					
			5	4	3	2	1	0
1.	QA/QC System/Service available*	A	5	4	3	2	1	0
2.	Quarrying and crushing operations	A	5	4	3	2	1	0
3.	Quality consistency of produced aggregates	A	5	4	3	2	1	0
4.	Storage facility/handling in pug mill	A	5	4	3	2	1	0
5.	Capacity/type of pug mill	A	5	4	3	2	1	0
6.	Skill of pug mill operatives	B	-	-	3	2	1	0
7.	Lab facility near pug mill	B	-	-	3	2	1	0
8.	Grading and moisture content of mix ATL pug mill – (Control skills)	B	-	-	3	2	1	0
9.	General safety, cleanliness, environmental care at pug mill	B	-	-	3	2	1	0
10.	Efficiency of transportation fleet, communication, discipline	A	A	4	3	2	1	0
11.	Adequacy of paver, compactor and efficiency at site.	A	A	4	3	2	1	0
12.	Paving controls at site (skills)	A	A	4	3	2	1	0
13.	Surface quality at site.	A	A	4	3	2	1	0
14.	Demonstrated improvement	A	A	4	3	2	1	0

* Factor A is graded on A scale 0 to 5 while factor B is graded 0 to 3. Scoring is done at every position.

Factor A score – $10 \times 5 = 50$

Max. = 62

Factor B score – $4 \times 3 = 12$

Acceptable score

36 on Factor A

6 on Factor B

Total = 42/62

DEFINITION AND TERMINOLOGY

A1. General

The terms defined below, when used in the context of Quality Systems, have acquired specific meanings and applications rather than the generic definition found in dictionaries.

Some of the definitions taken from ISO:8402 of 1994 are given under sub-groups A2 and A3. These terms have been further clarified in these codes by additional notes for which reference may be made to the code itself. The notes printed in bracketed in this section are added for clarifying the applicability for road construction.

It is also found necessary to define certain other general terms in order to clarify their usage in the quality field. Additional terms have been defined which have special context in highway engineering industry. These are included under sub-group A2.

A2. Sub-group of General Terms/Industry Terms

A2.1. Process

Set in inter-related resources and activities, which transform inputs into outputs. [In context of roads investigations, project preparations, design and construction are part-processes which contribute to road-building].

A2.2. Product

The result of activities or 'processes' (product may be a tangible product: intangible product, such as, knowledge or concepts, a design, directions for use).

Product may include provision of a 'service'. [In context of roads, these terms refer to the roads, its components and related services, as also to intermediate products of part-processes].

A2.3. Service

Result generated by activities at the interface between supplier and the customer, and by supplier's internal activities to meet the customers' needs.

A2.4. Supplier

Organization that provides a product to the customer includes person/group who has undertaken the responsibility of supplying a product/service to other person/group within its organization for further use.

[In context of roads, it usually refers to the Contractor, Material Supplier or Consultant]

A2.5. Purchaser/Customer

Recipient of a product includes person/organization who has taken a product/service from the supplier for onward delivery, with or without further processing, to other purchaser/customer or to owner/end user.

[In context of roads, it usually refers to the owner or contractor]

A2.6. Owner

The final authority/utility owning the end product.

[In road construction industry, this may be the governmental department/private party]

A2.7. End User

The actual user of the facility.

A2.8. End Use/End Product

The final product (service) to be produced (by the organization concerned with road construction industry in context of this guideline).

A2.9. Responsibility

Used in a general sense, this term indicates the explicitly stated or implied duty of the person/organization to perform and provide the service or product of required quality.

[It is also used in the contract documents for bridges in a sense of 'legal accountability' with or without pre-determined financial obligations (product liability/service liability as defined in A3.7.))]

A3. Sub-group of ISO:8402 Terminology**A3.1. Quality**

The totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs.

[Needs may include aspects of usability, safety, availability, reliability, maintainability, economics and environment, 'fitness for use', 'fitness for purpose' 'customer satisfaction' and 'conformation to requirements' represent facets of quality.]

A3.2. Grade

Category or rank given to entities having the same functional use, but different requirements of quality

Thus, grade reflects a planned or recognized difference in requirements for quality

[An article given rating of high grade as compared to similar articles of grade does not necessarily and automatically become adequate for satisfying needs.]

A3.3. Requirements of Quality

Expression of the needs or their translation into a set of quantitatively/qualitatively stated characteristics of an entity.

[These are the specifications of characteristics that a road should possess in order to achieve the aims of constructing the road.]

A3.4. Dependability

Collective term used to describe the availability, performance and its influencing factors: reliability performance, maintainability performance and maintenance supported performance.

A3.5. Conformity/Non-conformity

Fulfillment/non-fulfillment of specified requirements (A3.3) respectively.

[Generally, non-conformity should lead to rejection of item]

A3.6. Defect

The non-fulfillment of intended usage requirement or reasonable expectation including one concerned with safety.

[In context of roads, defect does not lead to rejection but to repair leading to conformance or acceptance of lower grade of quality]

A3.7. Product Liability; Service Liability

A generic term used to describe the onus on a producer or other to make restitution for loss related to personal injury, property damage or other harm caused by a product or service.

[The term 'responsibility' is more commonly used in road building to indicate contractual/legal accountability. (Refer 'responsibility' in A2.9)]

A3.8. Qualification Process

Process of demonstrating whether an entity is capable of fulfilling specified requirements.
[e.g., qualification of welding]

A3.9. Qualified

Status given to an entity when capability of fulfilling specified requirements has been demonstrated.

A3.10. Inspection/Self-inspection

Activities, such as, measuring, examining, testing, gauging one or more characteristics of a product or service and comparing these with specified requirements to determine conformity, when carried out by performer is called self-inspection.

A3.11. Verification

Confirmation by examination and provision of objective evidence that specified requirements have been fulfilled.

A3.12. Quality Policy

The overall quality intentions and direction of an organization as regards quality, as formally expressed by top management.

A3.13. Quality Management

That aspect of the overall management function that determines and implements the quality policy.

[Quality management includes strategic planning, allocation of resources and other systematic activities for quality, such as, quality planning, operations and evaluations]

A3.14. Quality Planning

Activities that establish the objectives and requirements for quality and for application of quality policy.

It covers product planning, managerial and operational planning and preparation of quality plan.

A3.15. Quality Control

The operational techniques and activities that are used to fulfill requirements for quality. All those planned and systematic actions necessary to provide confidence that a product or service will satisfy given requirements for quality.

[For effectiveness, quality assurance usually requires a continuing evaluation of factors that affect the adequacy of the design or specification for intended applications as well as verifications and audits of projection, installation and inspection operations. Providing confidence may involve producing evidence. It includes giving assurance to internal as well as external parties]

A3.16. Quality Systems

The organization structure, responsibilities, procedures, processes and resources for implementing quality management.

A3.17. Total Quality Management (TQM)

Management approach of an organization centered on quality, based on the participation of all its members and aiming at long-term success through customer satisfaction and benefits to all members of the organization and to society.

[TQM as long term aim of improving "Quality" itself]

A3.18. Management Review

A formal evaluation by top management of the status and adequacy of the quality system in relation to quality policy and new objectives resulting from changing circumstances.

[It may be carried by, or on behalf of customer.]

A3.19. Design Review

A formal, documented, comprehensive and systematic examination of a design to evaluate the design requirements and the capability of the design to meet these requirements and to identify problems and propose solutions.

[The capability of the design encompasses such things as fitness for purpose, feasibility, manufacturability, performance, reliability, maintainability, safety, environmental aspects, time scale and life cycle cost. Design review by itself is not sufficient to ensure proper design]

A3.20. Quality Manual

Document stating the quality policy describing the quality system of an organization.

[This is also referred to as Quality Manual]

A3.21. Quality Plan

A document setting out the specific quality practices, resources and sequence of activities relevant to a particular product, service, contract or project.

A3.22. Specification

The document that states the requirements with which the product or service has to conform.

[A specification should refer to or include drawings, patterns or other relevant documents and should also indicate the means and criteria, whereby, conformity can be checked]

A3.23. Traceability

The ability to trace the history, application or location of an item or activity or similar items or activities by means of recorded identification.

A3.24. Quality Loop; Quality Spiral

Conceptual model of interaction in activities that influence the quality of a product or service in the various stages ranging from the identification of needs to the assessment of whether these needs have been satisfied.

A3.25. Quality Surveillance

The continuing monitoring and verification of the status of procedures, methods, conditions, processes, products and services and analysis of records in relation to state references to ensure that specified requirements for quality are being met.

A3.26. Quality Audit

A systematic and an independent examination to determine whether quality activities and related result comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.

[This is not to be confused with 'surveillance' or 'inspection' which have the sole purpose of process control or product acceptance. It includes quality 'system audit' 'process quality audit', 'product quality audit' and 'service quality audit'. It can be partial audit covering limited aspects]

A3.27. Production Permit; Deviation Permit

Written authorisation, prior to production or before provision of a service, to depart from specified requirements for a specified quantity or for a specified time.

A3.28. Concession; Waiver

Written authorisation to use or release a quantity of material, components or stores already produced but which do not conform to the specified requirements.

[This should be for limited quantity or period, and for specific use]

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Model Project

Quality Plan



Model Project Quality Plan

Method Statement for Preparation of Project Quality Plan.

With reference to IRC: SP:57-2000

(Applicable to Owners, Engineers and Contractors)

- (1) Understand the clients requirements.
- (2) Evolve an organisation that can meet the requirements.
- (3) Write down the duties responsibilities of each individual in the organisation under Section 4.
- (4) Write down the procedures for project control and administration that are required to meet the client requirements, inclusive of recording system under Section 5.
- (5) Write down the procedure of purchase control and recording system under Section 7.
- (6) Describe the inspection and tests on materials, workmanship and acceptance standards, proposed checks and recording systems under Section 8.
- (7) Describe working methodology with responsibilities for every activity, their checks, recording systems under Section 8.
- (8) Identify the instruments/equipments required and proposal of calibration and recording under Section 10.
- (9) Describe procedures for dealing with works that do not conform to specifications or requirements (non-conformities) under Section 11.
- (10) Describe methods for auditing under Section 12.

Notes :

- (1) Ample use of formats in the IRC:SP:57-2000 is recommended.
- (2) If formats are not available, new formats may be developed to suit the project requirements.
- (3) The typical project quality plan illustrated is for reference only. Users of this manual are advised to amplify suitably.

PROJECT QUALITY PLAN - ROADS

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1. Purpose

This project specific quality plan is prepared to systematise all activities associated with planning, design, construction, quality control and quality assurance and thus meet the requirements of contract between _____ and _____.

1.1. Scope

Contents of this document are applicable to all works to be carried out by _____ company, like, engineering, procurement, construction, calibration, testing for the following activities

- Survey
- Temporary works for crusher, pugmill, hot mix plant, services detour, temporary detour, etc.
- Construction of cross drainage works
- Borrow area identification
- Roadway excavation, disposal of materials
- Construction of embankment/subgrade
- Granular sub base construction
- Water bound, wet mix macadam coarses
- Bituminous macadam, dense bituminous macadam, asphaltic concrete
- Road marking
- Road furnitures
- Landscaping
- Lighting
- The scope will be updated as required

1.2. Reference and Applicable Documents

The following documents are referred while preparing the project quality plan:

- Quality manual of the agency making this document *
- Contract documents, specifications and drawings.
- General specifications for roads and bridges issued by MOST.
- Indian standard codes, as applicable.
- IRC - codes of practice as applicable.

* The agency making this manual should have a quality manual of their own.

1.3. Definitions

In the context of this document the following abbreviations, words or phrases shall be taken to have the meanings assigned to them:

- Client _____ (Fill names as applicable)
- Contractors _____
- Consultant _____
- Engineer _____
- Engineers Representative _____
- Sub-contractor - agencies/piece rate workers engaged by _____
for carrying out temporary or permanent works under supervision or management of _____

- Vendor - any person, agency, firm or company contracted to supply material or provide
service in connection with this project in this contract vendors are _____

Quality - the totality of features and characteristics of a product or service that relies on its ability to satisfy stated or implied needs.

Quality Assurance - All those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirement for quality.

Quality Control - Operational techniques or activities (e.g., inspection or test) used to verify technical and quality requirements for services and or products.

Quality Audit - A systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.

Quality Plan - A document setting out the specific practices, resources and sequences of activities relevant to a particular product, service, contract or project.

Procedures - A documented description of the method to be adopted in performance of a given task and where applicable, accept or reject criteria for that task.

Inspection - Activities, such as, measuring, examining, testing, gauging one or more characteristics of a product or service and comparing these with specified requirements.

Non-conformity - Non fulfillment of specified requirements,

Corrective Action - An activity the intention of which, is to return a non-conforming item or action to a state of conformity. It also covers action taken to prevent further recurrences of non-conformity.

Concession - A formal approval by appropriate agency to authorise a deviation from the specification or design which does not effect the final function of the proposed specification or design.

Repair - The process of restoring a non conforming characteristic to a condition such that the item conforms to the original specified requirements, where such a repair or restoration is acceptable.

Inspection - A documented procedure showing systematic inspection and tests relating to a product and indicating the agreed inspection and hold points for the interested parties.

Hold Point - A state in the production cycle where inspection and/or tests are performed to determine the acceptability of the item for further processing.

Witness Point - A stage in the production cycle, when third party inspector, contractor or company representative, witness any inspection or test to determine the acceptability of an item for further processing.

Calibration - A comparison of two instruments, measuring devices or gauges (gauges in this sense will include manufacturing jigs and fixtures) one of which is of known accuracy and where applicable, traceable to an internationally recognized standard.

Non-Destructive Examination - The means by which the integrity or conformity of an item has to be assessed without resorting to destructive analytical procedures.

POLICY STATEMENT

2. Quality Policy

It is the policy of _____
(write name of agency)

To clearly define and meet quality requirements and to actively promote continuous improvements in all aspects of the works.

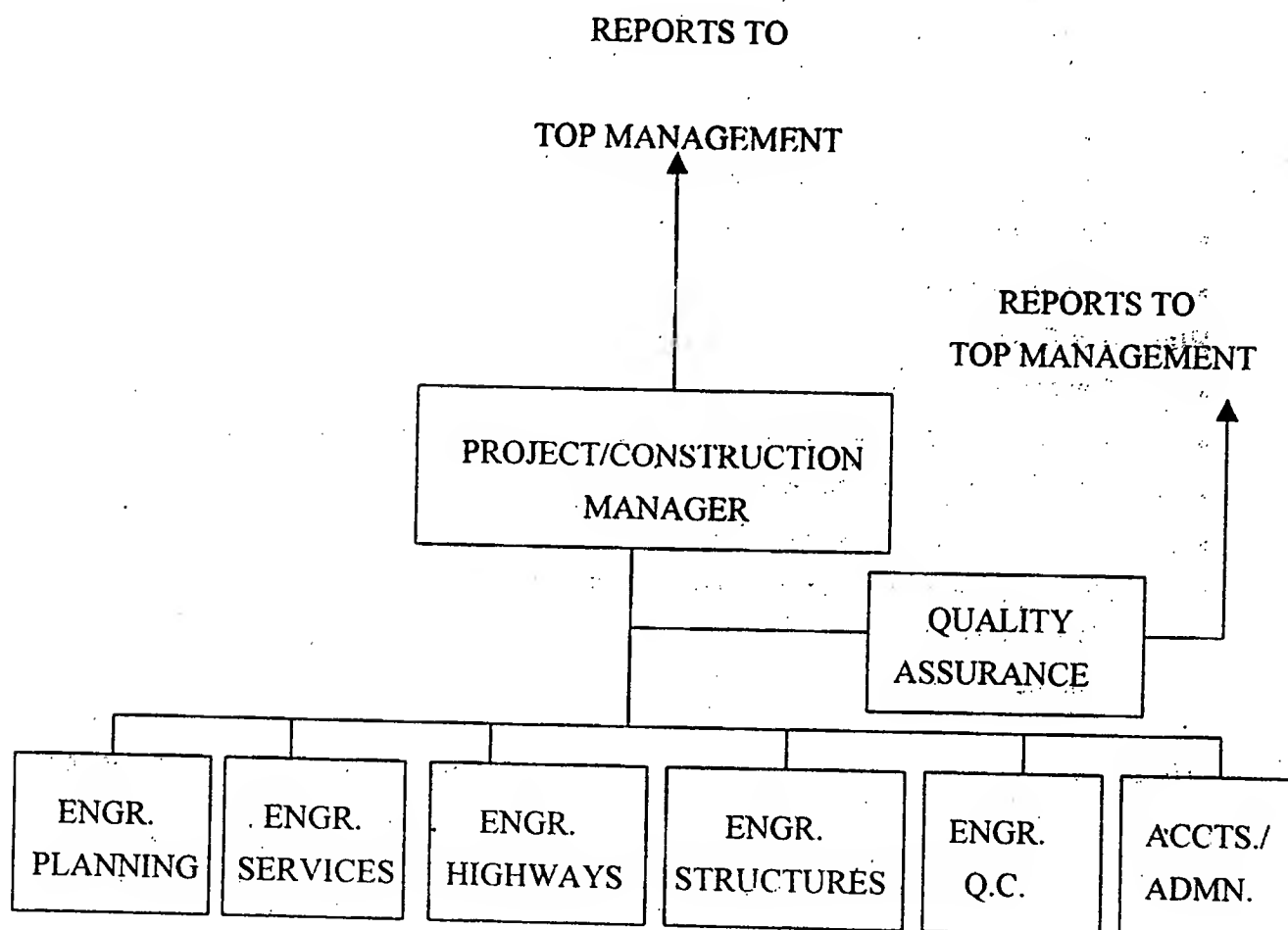
Our quality objectives are:

- Consistently achieve compliance with all contractual and environmental requirements.
- Achieve customer satisfaction.
- Implement departmental procedures consistent with the international standard requirements.
- To continually evaluate the quality system, seeking further improvements through regular assessment and review.

Authorised Signatory

Date:

3. Project Organisation (Flow Chart)



4. Project Organization (Duties and Responsibilities)

The project organization is shown in the organisation Section 3.

4.1. Responsibilities of the positions indicated in the project organization is explained hereunder:

4.2 Project/Construction Manager

- Reports to Senior Management.
- Liaison with other associated agencies or departments as applicable.
- Implements the project quality plan.
- Ensures harmonious interfaces between all sections in the organization.
- Responsible for quality, process and cost.

Planning Engineer

- Reports to the project/construction manager.
- Prepares construction program, monitors and reports to the management.
- Indents materials, plant, labour.
- Draws weekly and monthly plans.
- Handles contract documentation (Letters, drawings, etc.).
- Vendor qualification.
- Contract closing.

Note: The Responsibilities of other positions on the organization chart may be written in a similar fashion.

5. Project Control and Administration

This project will be administered by the project/construction manager and will conduct the following procedures as below:

5.1. Contract Review

Contract review will be done by the project manager/construction manager at monthly intervals. The review will comprise the following:

- (a) Design
- (b) Reference standards, method statements and work procedures
- (c) Construction time actual Vs. planned
- (d) Resource leveling
- (e) Cost Review
- (f) Quality Review

All reviews will be done with a view to meet contract requirements. Review proceedings will be documented, informed to senior management by copies of proceedings. Originals will be filed in Planning Engineers office in files of green colour coding. (The site is free to choose the colour coding). Review of item c, f above is illustrated.

5.2. Variations - Contract Variations Raised by Client or Contractor will be reviewed to assess its impact on

- (a) Schedule
- (b) Cost
- (c) Resources

Variations will be documented, variation compensations will be discussed and agreed. All documentation will be processed by the Planning Engineer, distributed to senior management delegated to authorise such acts. Originals will be filed in the planning section in files of yellow colour coding.

5.3. Project Planning and Scheduling

Scheduling and planning will be achieved by computer based programs, like, MS projects, primavera or manual methods. (Please write as applicable to your project.)

This exercise will be done at monthly frequencies.

The exercise will review progress, cost, plant, resources etc. against planned and document remedial measures to overcome any deficiency.

All documentation of this procedure will be maintained by the planning section, copied to senior management. Originals will be retained in planning section in blue colour coded files

Monthly reporting of the above reviews will be sent to senior management/clients as applicable. Refer project office generated procedures.

Note : Readers are requested to include formats as applicable that will ensure an efficient contract administration.

e.g., Standard letters, drawing transmittals, weekly, monthly program and review sheets, file maintenance system, etc.

Contract Review – Illustration Only

Format 5.1.C: Construction Time Actual Vs. Planned

(To be initiated by the Project Manager - copies of Review Proceedings to be sent to Client, Contractors, Senior Management).

Project - S.B.Highway Section - 4 Month - May 1996 Date of Review 01 June 1996.

Review by Col. B.K.Maitra

Sl.No.	Activity	Qty. Total	Planned	Achieved	Remarks
1.	Excavation	8000 M ³	6000 M ³	4000 M ³	Poclain B/o 40 hrs.
2.	Subgrade	12000 M ³	12000 M ³	10000 M ³	High moisture at Km 154-152
3.	Granular Sub Base	8000 M ³	8000 M ³	7900 M ³	
4.	Wet Mix Macadam	-	Not Planned	-	
5.	DBM	-	Not Planned	-	
6.	BC	-	Not Planned	-	

Remarks and Action :

- (1) Additional Poclain is required to make up the shortage. This is being arranged for a week from package S3 contract adjacent, where the equipment is declared surplus.
- (2) Subgrade - A disk harrow is being mobilised to overcome this problem.

PROJECT MANAGER

Copy to : 1. Executive Engineer – PWD, 2. Regional Manager, 3. General Manager, and
4. Planning Office - Green Folder File.

Format 5.1.F: Quality Review – Example

Month : June 1996

Project : SR HIGHWAY

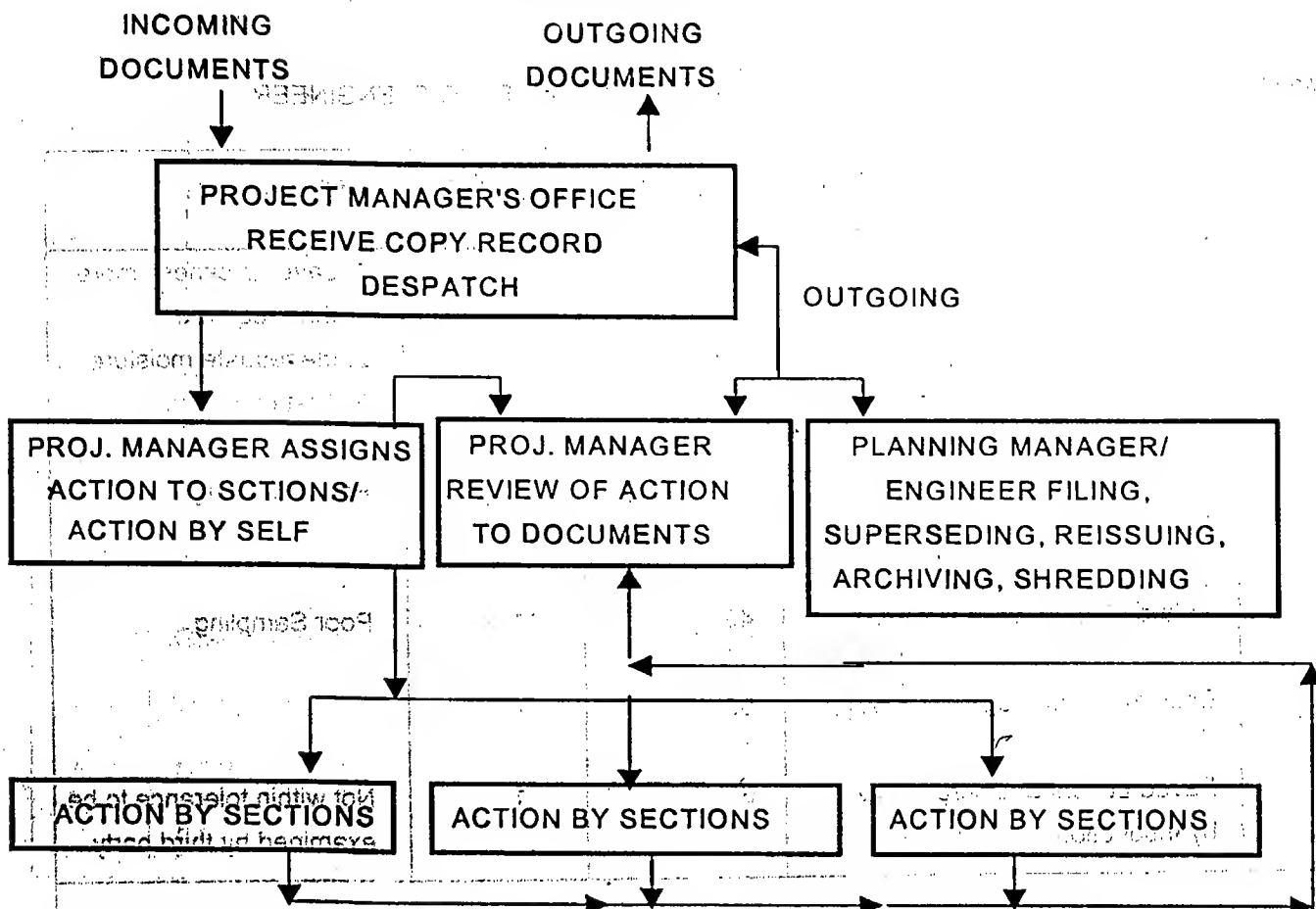
Compiled By : Q.C. ENGINEER

Sl.No.	Item of Work	No. of Tests	No. of First Time Passes	Failures	Remarks
1.	Compaction Sub Grade	100	90	10	1. Layer thickness more than required 2. Inadequate moisture 3. Test on edges
2.	Concrete Cubes Compression	50	45	5	Poor Sampling
3.	Asphalt Gradation	50	49	1	Poor Sampling
4.	Bitumen Percentage	50	50	-	
5.	Paved Levels Checked by Inspection	10	9	1	Not within tolerance to be examined by third party
Remarks :					Action 1. Layer thickness to be checked Site 2. Use speedy moisture test Lab 3. Follow test procedures for compaction Lab 4. Modify sampling techniques Lab

PROJECT MANAGER

Copy to : 1. Executive Engineer, 2. Regional QA Manager, 3. All sections as marked, and
4. Planning Office - Yellow Folder File.

6. DOCUMENT CONTROL



- (1) Project Managers office receives, acknowledges, records incoming documents.
- (2) Project Manager assigns actions to departments/self.
- (3) Actions by departments reviewed by Project Manager.
- (4) Project Manager decides actions, like, file, supersede, archive, shred and instructs planning.
- (5) Documents going out are signed by Project Manager.
- (6) Project Managers office records outgoing mail/documents.
- (7) Arrows indicate direction of processing.

6.1. Document Control Procedure

Sl.No.	Activity	Action	Responsibility	Remarks
(1)	Receive, date stamp, log all incoming mail.	Date, stamp, record	Secretary	Log in register see sample
(2)	Put up for Project Manager's Review		Secretary	
(3)	Project Manager's Review Action by Project Manager – Planning, Section Engineer, Accounts Department	Distribute copy to section	Secretary	Retain original in day file.
(4)	Project Manager's Action - Send reply document and file copy as per filing system 6.1.(b)	File	Secretary	Outgoing letters to indicate filing nos. log in - out register.
(5)	Letter, originated by all departments are signed by Project Manager, copied to allotted files.	File	Secretary	
(6)	All filing system, day register maintained by Planning Engineer		Planning Engineer	

6.1.(a) Drawing Register – Illustration

(Maintained at Planning Office, updated for each drawing receipt.
Copied at Monthly Intervals to Section Engineers)

Sl.No.	Title	Revision Date					Remarks
		0	1	2	3	4	
(1)	Longitudinal Profile	15/2	20/9	15/12			
(2)	Cross-Sections CH140-155	20/2					
(3)	Architectural Details - Minor Bridge 104	15/8	20/10				

6.1.(b) Master Filing System - Illustration

(To be displayed on table tops of Project Manager - Planning, Secretary and Section Heads)

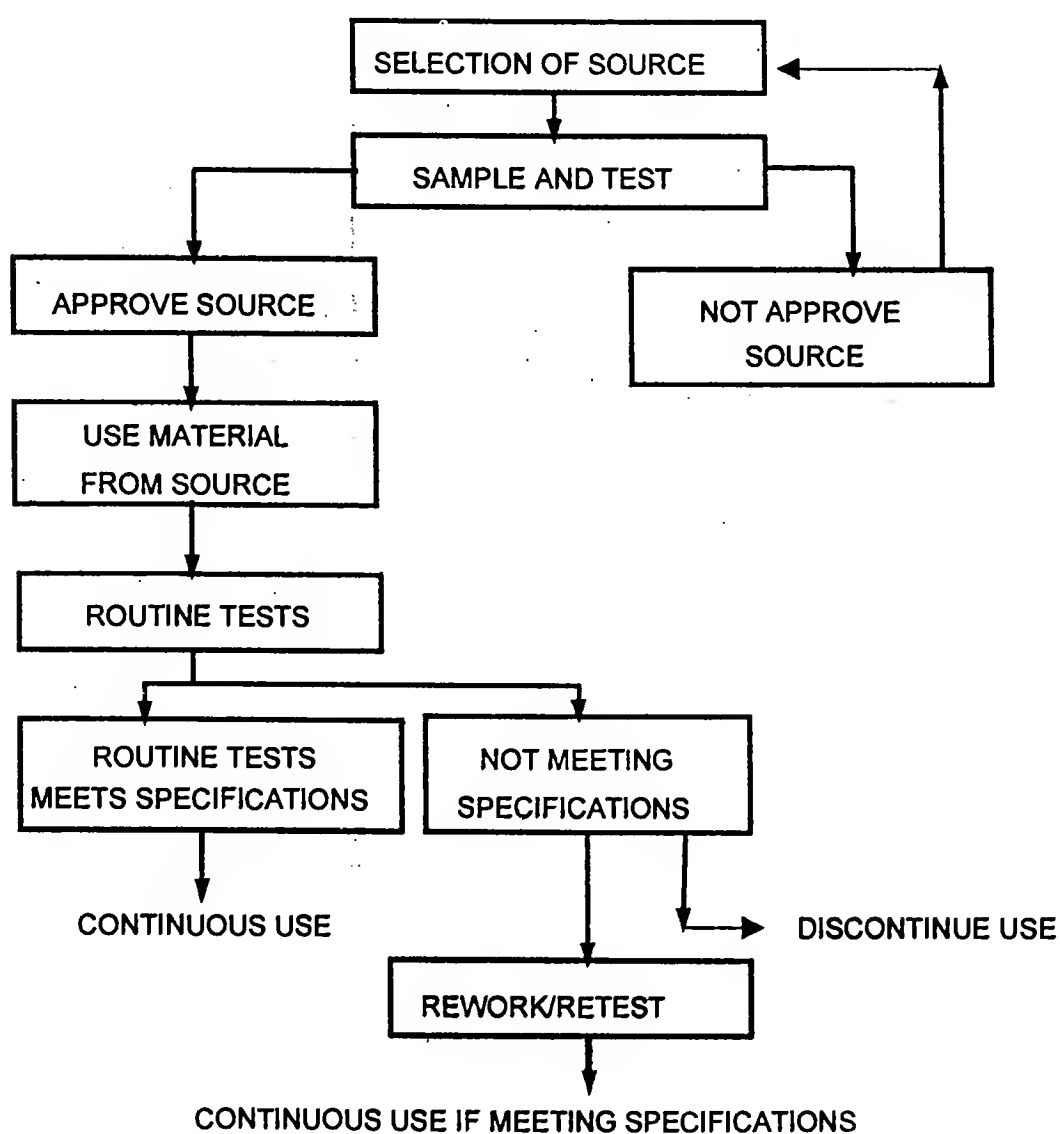
Yellow		Green	
File Ref.	Title	File Ref.	Title
1.00	Incoming mail register	3.00	Progress reports to clients
1.01	Outgoing mail register	3.01	Legal matters
1.02	Telephone/Telex/Fax	3.02	Taxes
1.03	E-mail	3.03	Government matters
1.04	Wireless	3.04	Cleaning and screening
1.05	Office equipment		
1.06	Quotations		
1.07	Drawing register		
Red		Orange	
2.00	Plant	4.00	Materials - General
2.01	Spares	4.01	Tests in-house
2.02	Calibration	4.02	Tests third party
2.03	Mix designs	4.03	Reinforcement
		4.04	Aggregates
		4.05	Concrete
		4.06	Bitumen

This is to be expanded to suit project needs.

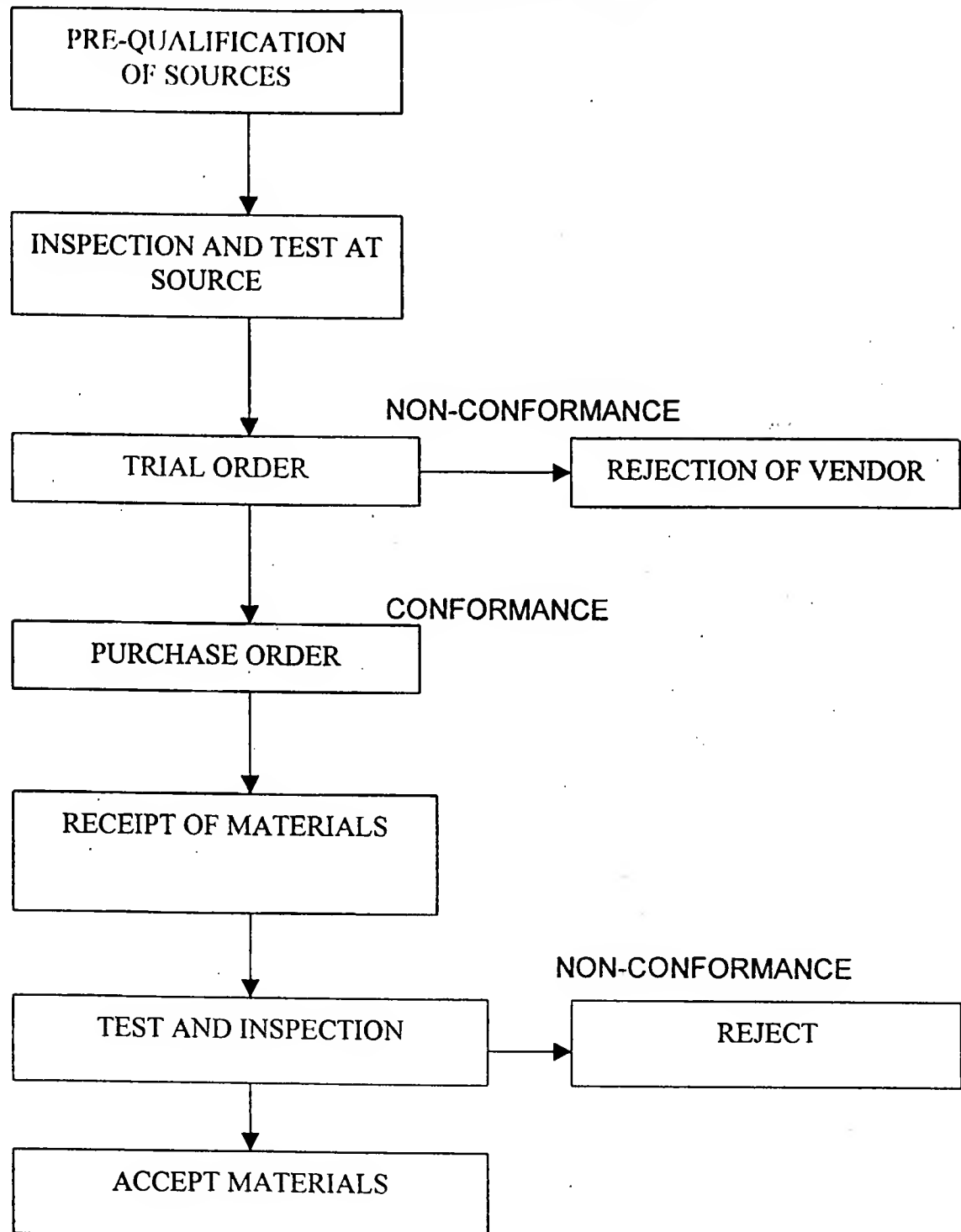
7. Control of Materials

Project execution requires use of construction materials of natural origin and manufactured items. Materials for use in permanent/temporary works should conform to the contract specifications in both the cases. The steps that will be adopted for control of these materials is represented by flow charts for each of the above category. The procedure for material procurement will be as per flow chart.

7.1. Construction Materials of Natural Origin



Note: All steps in the flow chart require documentation and records

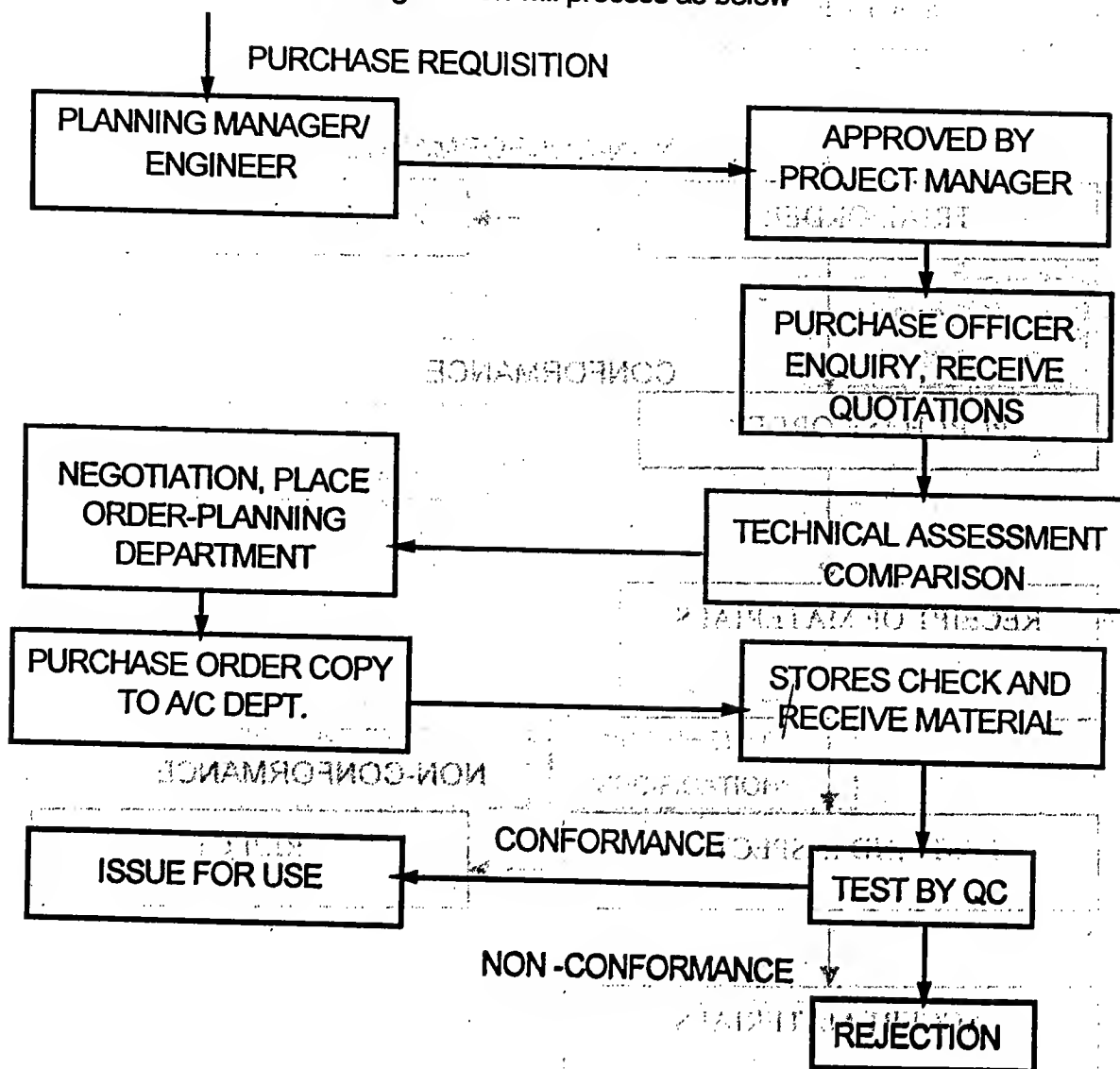
7.2. Flow Chart for Procurement of Manufactured Items

All steps in the flow chart require documentation and records.

7.3. Office Procedure for Material Procurement

User to issue material purchase requisition containing

- * Specifications
- * Test requirements
- * Drawings if required
- * Planning section will process as below



Note : All steps in the flow chart require documentation and records.

7.4. Procedure for Control of Materials-Refer Tables 7.1 to 7.3

S. No	Activity	Action By	Check By	Remarks
(1)	Estimate material quantities with reference to Drgs. and Specs.	Section Engineers	Planning Engineer	All quantities in respective material files section 3 of system.
(2)	Prepare requirement plan	Section Engineer	Planning Engineer	Record in formats made for this purpose.
(3)	Float enquiries enclosing specifications	Purchase Officer	Planning Engineer	
(4)	Collect samples, test independently	Planning Engineers/ QCE	QA	
(5)	Approve source	QCE		Some contracts require source approval by consultants.
(6)	Place order, receive materials, sample, test	Purchase Officer/ Stores	QCE	Stores to stack untested material at locations designated for the purpose.
(7)	Receive test reports, if within specs, approve for usage	QCE	QA	QCE to inform stores on standard formats.
(8)	If routine tests not conforming, inform stores in writing. Segregate this material.	QCE	QA	Rejected material to be highlighted in front of locations by flags and removed to locations out of bounds for staff or labour.
(9)	If source fails consistently discard source	QCE	QA	
(10)	Qualify another source vide steps 4, 5	Planning Engineer, QCE	QA	

7.4. (a). Material Receipt Note - Illustration

(To be initiated by stores, copy to Planning and Quality Control Engineer)

DATE : 20/05/95

Material Description : 20 mm aggregate

Vehicle No. KA 02N1526 Delivery Challan No. ECC SOL1265

Source : Soolivara Unloaded and stored at: Binny yard

Tests Certificates, if any: Source tested by QCE : samples acceptable.

Material Identification Boards: Inspected / Not Inspected/Approved for Use/ Rejected
Place Boards
(Tick as applicable)

Purchase Order No. _____

Remarks : _____

STORE KEEPER:



IRC:SP:57-2000

7.4. (b). Internal Test Reports – Illustration

(To be initiated by QCE, copy to stores, planning and the user section)

DATE

- | | | |
|-----|------------------------------------|---|
| (1) | Material Description: | Reinforcement dia 32 mm high yield |
| (2) | Sampled from: | SAIL yard stack No.35 test No.2695V |
| (3) | DC Reference: | Nil |
| (4) | Tests meeting/Not meeting specs: | Yield is 385 mpa against 415 required |
| (5) | Instruction to store * | Do not lift the material from SAIL yard |
| | (a) Issue for use | |
| | (b) Hold till further instructions | |
| | (c) Remove from store yard | |

* Tick as applicable. Strike items not applicable.

QC ENGINEER

Copy to stores, purchase, planning.

Category A: Planning Proforma A-2

QUALITY PLAN FOR BITUMEN

Sr. No.	Description Tests/Items	Acceptance Standard	Performance Standard	Performing Agency	Quality Assurance Agency	Frequency of Performance	Frequency of Assurance	Frequency of Audit
1.	Prequalification of source	Project Specification IS73	Project Specification IS73	E/C	QA/E	New Source	New Source	1
2.	Procurement	Project Specification IS73	Project Specification IS73	Agency Responsible For procurement	QA/E	Well in advance	Well in Advance	1
3.	Storage	Project Specification	Project Specification	C	QA/E	After receipt at Site	Once in month	1
4.	Sampling	Project Specification	Project Specification	E/C or Jointly	QA/E	Each fresh Lot	Once in week	1
5.	Test: Physical	Project Specification IS73	Project Specification IS73	E/C	QA/E	East lot	Once in week	1
6.	Chemical	Project Specification IS73	Project Specification IS73	E/C	QA/E	As per requirement	As per requirement	1
	Records	Project Specification	Project Specification	E/C	QA/E	Daily	Once in month	1

E: Engineer / Owner C: Contractor TP: Third Party QA: QA UNIT 1: Once in a year or Project Specific

Prepared by
(for QA Team)

Sign:

Date:

Approved by:
(For Engineer)

Sign:

Date

QUALITY PLAN- GRANULAR SUB BASE

Sr. No.	Description Tests/Items	Acceptance Standard	Performance Standard	Performing Agency	Quality Assurance Agency	Frequency of Performance	Frequency of Assurance	Frequency of Audit
1.	Control Tests on Materials laid at site	IS	Table 900-3 MOST	C	QA/TP	Table 900-3 MOST	Monthly	1
2.	Mixing of Materials and Moisture Content Check at Yard	IS / MOST	Table 900-3 MOST	C	QA	Table 900-3 MOST	Monthly	1
3.	Compaction Tests	IS / MOST	Table 900-3 MOST	C	QA	Table 900-3 MOST	Monthly	1
4.	Surface Regularity Checks	MOST Table 900-1	Every Compacted Layer	C	TP	Every Layer	Monthly	1

E: Engineer / Owner C: Contractor TP: Third Party QA: QA UNIT 1: Once in a year or Project Specific

Prepared by
(for QA Team)

Sign:

Date:

Approved by:
(For Engineer)

Sign:

Date

Category A: Planning Proforma A-4

QUALITY PLAN – WET MIX MACADAM

Sr. No.	Description Tests/Items	Acceptance Standard	Performance Standard	Performing Agency	Quality Assurance Agency	Frequency of Performance	Frequency of Assurance	Frequency of Audit
1.	Control Tests on Materials laid at	IS	Table 900-3 MOST	C	QA/TP	Table 900-3 MOST	Monthly	1
2.	Grading of Paved Material, Moisture check at paving	IS		C	QA/TP	Weekly	Monthly	1
3.	Compaction Tests	IS	Table 900-3 MOST	C	QA/TP	Weekly	Monthly	1
4.	Surface Regularity	MOST Table 900-1	Every Layer	C	QA/TP	Weekly	Monthly	1

E: Engineer / Owner C: Contractor TP: Third Party QA: QA UNIT 1: Once in a year or Project Specific

Prepared by (for QA Team) Sign: Date: Approved by: (For Engineer) Sign: Date:



METHODOLOGY 001

8.1. Project Quality Plan - Survey

Establishment of Permanent and Temporary Bench Marks

OBJECTIVE - Establishment permanent and temporary bench marks with respect to GTS bench marks of the survey of India.

PURPOSE - Achieve proper level control to pavement layers and structures during construction.
Monitor future settlement.

Sl. No.	Procedure	Responsibility	Check by	Record/Tests
(1)	Conduct reconnaissance survey along alignment. Decide positions to construct monuments at locations least disturbed by construction.	Surveyor/special agency	Highway Engineer	Surveyors daily report and sketches - format F 001
(2)	Construct Permanent Monument of size 150 x 150 x 450 mm deep with 300 mm projection from ground. At row boundary	Section Engineer	Surveyor	Nil
(3)	Protect monument by fencing designate monument by nos.	Section Engineer	Surveyor	Daily report/ drawing of BM locations
(4)	Back sight known GTS stations and transfer values to monuments already established	Surveyor/special agency	Highway Engineer, random check by third party	Daily report/ Drawings
(5)	*Close traverse on different GTS bench mark	Surveyor/special agency	Highway Engineer	Daily Report
(6)	Establish temporary benchmarks in between monuments as required for work Close traverse on known stations	Surveyor/special agency	Section Engineer	Daily Report
(7)	Recheck benchmark values 6 month intervals with respect to GTS any settlement.		Special agency	
(8)	Sketch BM locations and values - distribute	Surveyor		Distribute data to all engineers associated with construction

Tolerances in mm $8(K) \frac{1}{2}$ where k is distance in Km.

Note : Format 001 to be submitted to Highway Engineer every day.

METHODOLOGY - 002**Methodology of Working - Wet Mix Macadam**

OBJECTIVE : Construct wet mix macadam base coarse to be required width levels and centre line and other structural requirements.

PURPOSE A well constructed road base disperses wheel loads favourably to the subgrade layers.

Sl.No.	Procedure	Responsibility	Check by	Records/Tests
(1)	Identify material sources that will meet MOST requirements.	Material Engineer	Planning Engineer	
(2)	Conduct initial tests. Confirm acceptability as per MOST Specs. Tables 400-10, 400-11.	Material Engineer	Planning Engineer	Lab records for various tests.
(3)	Monitor crusher output, establish mix proportions such that the same satisfies specifications as well as proper usage of various fractions from crusher	Material Engineer	Planning Engineer	Crusher records/Lab records
(4)	Conduct laboratory trials on this mix. Establish MDD, OMC.	Material Engineer	Planning Engineer	Lab Records
(5)	Commission soil stabilisation plant, calibrate bin and water addition facility.	Material Engineer	Consultant	Calibration records.
(6)	Trial production, trial laying and compaction	Material Engineer/ Site Engineer	Consultant	Records, documentation of all activities.
(7)	Check trial track for compaction, desired levels. If acceptable, write work procedure. If no repeat trials.	Material Engineer/ Site Engineer	Consultant	Records
(8)	Commence permanent works production and paving. Conduct tests as per inspection plan.	Material Engineer/ Site Engineer	Consultant	Records
(9)	Audit work procedure steps, records as per inspection plan.	TP	Client	Audit Report
(10)	Maintain all relevant records in standard formats as per proforma.	Material Engineer/ Site Engineer	TP	Audit Report

DAILY SURVEY REPORT

(RECORDED BY SURVEYORS - SUBMIT TO PLANNING ENGINEER)

DATE:

WORK CARRIED OUT DETAILS:

SPECIFICATION:

DONE BY

CHECKED BY

9. Third Party Inspection

9.1. Sampling and testing of materials/works listed under will be subject to test by third parties at frequencies as indicated

Sl.No.	Material	Frequency of Tests	Tests at	Responsibility
(1)	Cement	Every 500 MT of receipts or 3 months whichever is earlier	IIT	QCE
(2)	Reinf Steel	Every delivery	SAIL LAB	QCE
(3)	Bitumen	Every 500 MT	CRRI, Delhi	QCE
(4)	Coarse Aggregates	Every change of source	CRRI	

9.2. Third Party Inspection-Works

Sl.No.	Work Description	Frequency of Tests	Tests at	Responsibility
(1)	Density tests subgrade	Once per week	Site	Highway Research Station
(2)	Surface levels sub base	Once per week	Site	Third party agency
(3)	Surface Regularity Pavement Courses	Once per week	Site	Third party agency
(4)	DBM Batching	Once per week	Hot mix plant	Third party agency
(5)	Centre Line Marking	Once in three months	Site	Third party survey agency

Note: The tabulations are examples only. Project quality writers to follow the contract requirements. Workmanship can also be third party tested, as illustrated in 9.2.

10. Calibration

Measuring devices listed below will be calibrated prior to putting to use and at frequencies as noted:

Sl.No.	Instrument	Frequency	Calibration at
(1)	Auto levels	Monthly	Site
(2)	Theodolites	Monthly	Site
(3)	Distomats	6 Months	Manufacturers Works
(4)	Weigh batchers	6 Months	Site
(5)	Batching plants	6 Months	Site
(6)	Pugmill	6 Months	Site
(7)	Cube Testing Machine	Yearly	Site

Note : All calibration procedures will have to be documented in formats category C.
A calibration register and status of calibration is also to be maintained.

11. Non-conformity and Corrective Actions

11.1. Definition- Non-conformity is a deficiency in charter, procedure or other requirement which renders the quality of an item unacceptable with respect to some defined criteria, e.g., physical defects, test failures, incorrect procedures.

11.2. Classification of Non-conformity and Corrective Action

It is proposed to classify non-conformities and procedure for dealing with non-conformities. As per flow charts Figs.11.2.1 and 11.2.2 which are self explanatory. Procedures will be evolved as per the flow chart guidelines.

Fig. 11.2.1. DEALING WITH NON-CONFORMING WORKS

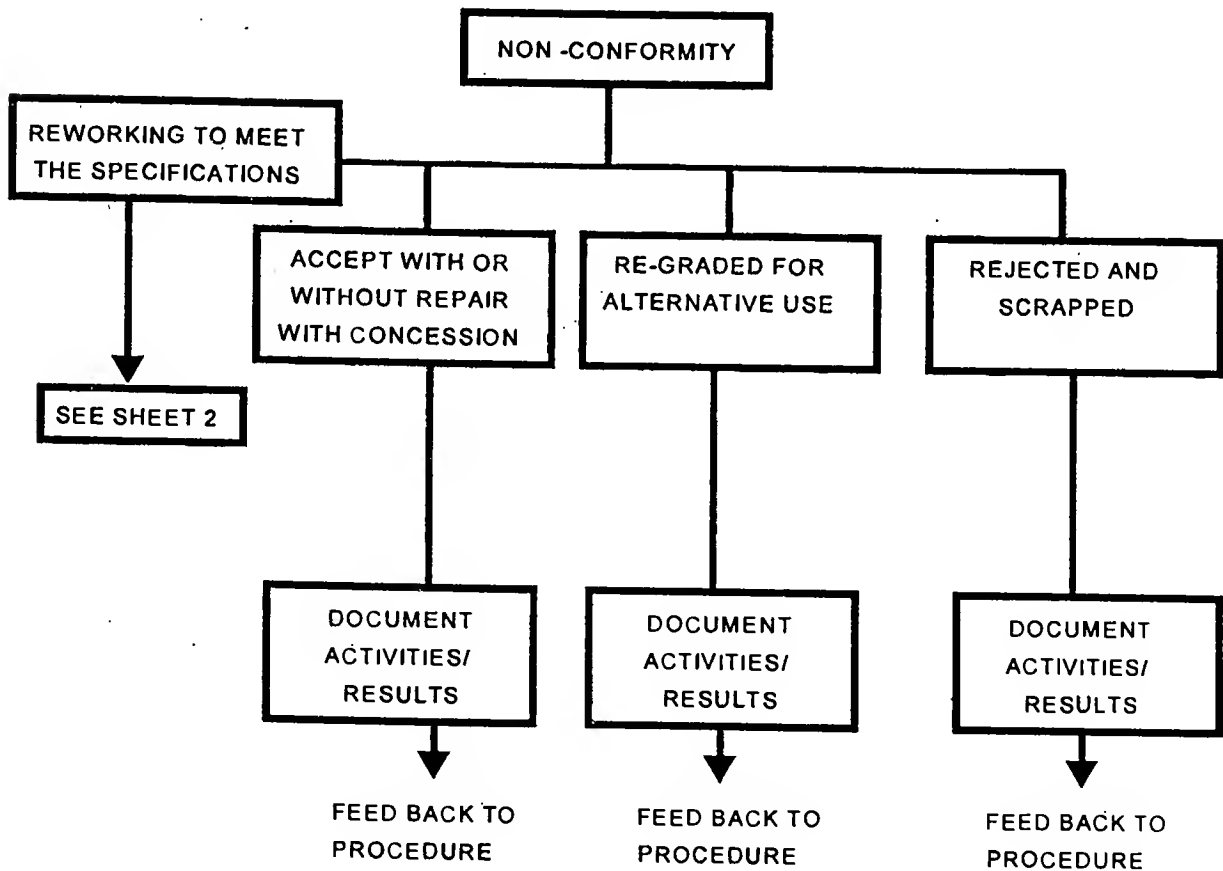
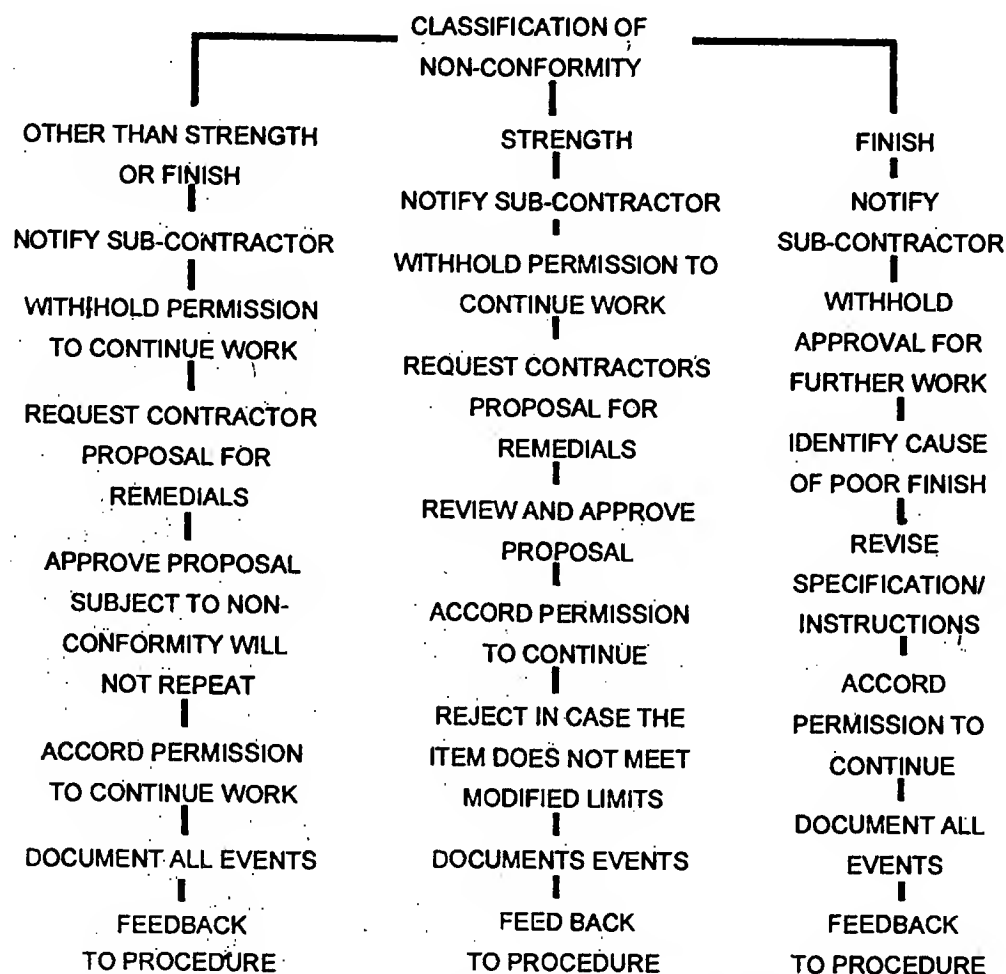


Fig. 11.2.2. DEALING WITH NON-CONFORMING WORKS

SHEET-2



* The Engineer/Owner to be informed as marked.

11.3. Non-Conformity and Corrective Actions - Audit - Illustration

Non-conformity is deficiency in character, procedure or product. The implementation of corrective action commence with detection of non-conformity. This is explained with reference to activity of survey methodology Section 8.1.

Sl. No.	Activity	Responsibility	Check by	Remarks
(1)	Audit of procedure "Establishment of permanent and temporary bench marks"	QA Engineer		
(2)	Step 1 - Records for reconnaissance survey and sketches available			Conforms to procedure
	Step 2 - Permanent BMs project 300 mm above ground			Conforms to procedure
	Step 3 - Monuments not protected and designated			Minor non- conformity
	Step 4 - Back sighted to GTS			Conforms to procedure
	Step 5 - Not closed transverse on GTS BM			Major Non- conformity
	Step 6 - TEMP BM established			Conforms to procedure
	Step 7 - BM values not checked every 6 months			Major Non- conformity
See Non-Conformity and corrective action report.				

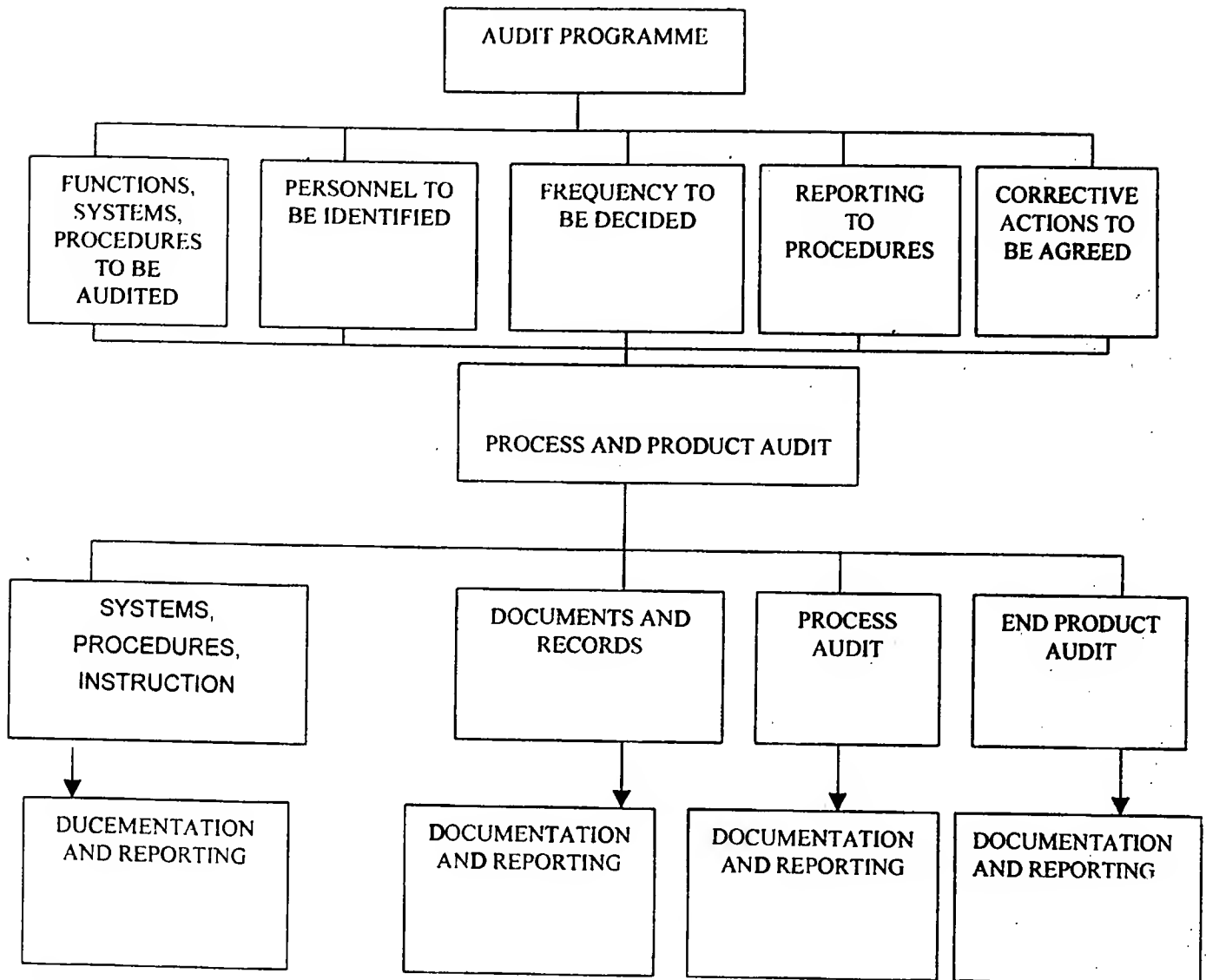
11.4. Non-Conformance/Corrective Action Report - Illustration

Department Audited	-	Survey	Audit Report No. - 1				
Auditor	-	K.P.Sreehari	Date : 16/06/98				
Audited Procedure	-	System					
Non Conformance	-	Monuments not protected	Minor				
	-	Traverse not closed	Major				
	-	No evidence of check of bench Marks values every 6 months	Major				
In view of two major non conformities, the works are temporarily suspended till implementation of corrective actions.							
Auditor's Signature	NCR Category (Tick One) (See Reverse Page)						Dept. Rep. Signature
	1	2	3	4	5	6	
Proposed Remedial Action (1) Monuments will be protected (2) The unclosed traverse will be closed by 20.06.98 (3) Bench mark values will be checked by 20.6.98							
Proposer	G N Saha						Completion Target Date : 20.6.98
Corrective/Preventive action Completed on 20.06.99 Re-audit procedure 20.07.99 Signature of Proposer							
Copy 1 – General Manager		2. Construction Manager			3. Department Head		

Category	1.	Procedure followed but not documented	-	Minor
	2.	Procedure changed but not amended in records	-	Minor
	3.	Documentation not upto date	-	Major
	4.	Check lists and records not authenticated	-	Major
	5.	Procedures not followed, remedials may restore quality	-	Major
	6.	Procedures and documentation inadequate	-	Major
		Product not to acceptable standards. Requires rejection.		

12. Quality Audits

Quality



Notes:

- Prepare audit schedule - distribute to sections.
- Issue audit notification.
- Prepare audit check list prior to audit.
- Conduct audit.
- Complete audit report.
- Complete non conformance and corrective action report.
- Monitor compliance to audit recommendations
- Close non-conformity report

[illegible]

12.2. Audit Notification

To :	
cc :	
This notification is to advise you that an Audit has been scheduled to take place in your Company/ Department/Area as detailed below. Please acknowledge receipt of this notification by signing and returning a copy of this form to the QM - Department as soon as possible.	
AUDIT DETAILS :	
Audit Number:	
Date Planned:	
Time:	
General Agenda:	
Documents to be audited:	
The Audit Team will be:	
The following personnel will be required to be available during the audit :	
Approved Management Representative :	Received by (Title) :
Signed :	Signed :
Date :	Date :

12.3. Audit Checklist

Area Audited :	Audit No. :	Auditor :	Approved QA-Manager:
Checklist	Activity Compliance*	Comments	
*Complete Activity Compliance column with one of the following:			
"Acceptable",	"Not acceptable",	"Not applicable",	"See Comments".

12.4. Audit Report

Date of Audit :						
Previous Audit Report :						
Audit Team :						
Persons Contacted :						
Audit Scope and Objective :						
Audit Summary :						
<div style="display: flex; justify-content: space-between; padding: 5px;"> Category : 1 2 3 4 5 6 </div>						
NCR's Issued:						
Observation Issued :						
Auditor:			Management Representative:			
Signature:			Signature :			
Date :			Date:			

12.4. Audit Report (Contd.)

Introduction

Audit Performance

Close-out Meeting

Attachments

Systems Improvement Suggestions

12.5. Non-Conformance Report (NCR) - Illustration

Department Audited :				Audit Report No.			
Auditor(s)/Author :				NCR No. :			
Audited Procedure :							
Non-Conformance Statement :							
Objective Evidence :							
Department Rep. (Sign) 		NCR Category (Tick One) (See Reverse Page)				EN ISO 9001 Reference:	
		1	2	3	4	5	6
This form to be returned to QM by							
Proposed Remedial Action							
Proposer..... Completion Target Date:.....							
Corrective/Preventive action: (necessary y/n)							
Proposer Completion Target Date :							

- Category:
- | | | |
|----|--|---------|
| 1. | Procedure followed but not documented | - Minor |
| 2. | Procedure changed but not amended in records | - Minor |
| 3. | Documentation not upto date | - Major |
| 4. | Check lists and records not authenticated | - Major |
| 5. | Procedures not followed, remedials may restore quality | - Major |
| 6. | Procedure and documentation inadequate | - Major |
| | Product not to acceptable standards. Requires rejection. | |



Rv/IRC/107

IRC:SP:57-2000

13. Safety

The project safety plan to be prepared separately by the Safety Engineer will cover safety procedures associated with road works for the following:

- Detours
- Signing and lighting temporary
- Working close to HT & LT cables
- Working close to High Pressure Water/Gas mains
- Working close to canals/rivers
- High embankment construction
- Working during poor visibility conditions
- Removal of obstructions to traffic
- Safety procedures at quarries, crushers and other plant
- Safety procedures for decanting bitumen
- Safety procedures for handling hot mix, paving operations, etc.

Safety Organization

The project safety team will comprise of the Safety Engineer and staff trained for works of such magnitude with access to equipments like rescue vehicles, first aid, water bowser etc. The proposed safety plan will cover in detail such facilities.